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of

The Danish Biological Station

to

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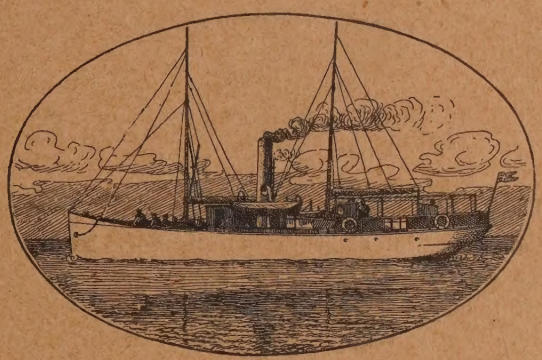

XXIV.

1916.

By

C. G. Joh. Petersen,

Ph. D., L. L. D.

Director.

Copenhagen.

In Commission by G. E. C. Gad.

Centraltrykkeriet.

1917.

C. G. Joh. Petersen: Om de skalbærende Molluskers Udbredningsforhold i de danske Have indenfor Skagen 1888. 8°. 1162 pg. 2 Kort.

Det videnskabelige Udbytte af Kanonbaaden »Hauch«s Togter i de danske Have indenfor Skagen. 1893. 4°. 464 pg. Atlas i folio.

Indhold: Echinodermata (Petersen), Diatomeer (Cleve), Undersøgelse af nogle Bundprøver (Rørdam), Mollusca (Petersen), Cephalopoda (Posselt), Crustacea malacostraca (Meinert), Hydrografi (Rørdam), Polyzoa (Levinsen), Ascidiæ simplices (Traustedt), Annulata, Hydroidæ, Anthozoa, Porifera (Levinsen), Nogle alm. Resultater (General Results Engl.) (Petersen).

C. F. Drechsel: Oversigt over vore Saltvandsfiskerier med Kort og Planer. 1890. 4°, 100 pg. Med et Tillæg: »Om Naturforholdene indenfor Skagen« af *C. G. Joh. Petersen*. Med Kort. 4°. 46 pg.

Fiskeri-Beretning for $18^{88}/_{89}$ til 1915.

Beretninger fra den danske biologiske Station findes paa dansk publicerede i de tilsvarende Fiskeri-Beretninger, til Beretning XXI med Tillæg. Senere udgives de som selvstændige Publicationer paa Dansk og paa Engelsk.

The Reports from The Danish Biological Station are also published in Danish in the corresponding Fiskeri-Beretning, until Report XXI with Appendix. Later on they are specially published both in Danish and in English, and not in the Fiskeri-Beretning.

I. Fiskenes biologiske Forhold i Holbæk Fjord. 1890—91. 63 pg. Med et Kort.
II. Om vore Kutlingers *(Gobius)* Æg og Ynglemaade. 1892. 9 pg. Med 2 Tavler.
II. On the Eggs and Breeding of our Gobiidæ. 1892. 9 pg. Two Plates.
III. Det pelagiske Liv i Fænø Sund etc. 1893. 38 pg. Tabeller.
III. The Pelagic Life in Fænø Sound etc. 1893. 38 pg. Tables.
IV. Om vore Flynderfiskes Biologi og om vore Flynderfiskeriers Aftagen. 1894. 146 pg. 2 Tavler. 1 Kort og mange Tabeller.
IV. On the Biology of our Flat-fishes and on the decrease of our Flat-fish Fisheries. 1894. 146 pg. 2 Plates. 1 Chart. Many Tables.
V. Den alm. Aal (*Anguilla vulgaris* T.) anlægger før sin Vandring til Havet en særlig Forplantningsdragt. 1896. 35 pg. Med 2 Tavler.
Etc. 64 pg.
V. The common Eel (*Anguilla vulgaris* T.) gets a Particular Breeding-dress before its Emigration to the Sea. 1896. 35 pg. With 2 Plates.
Etc. 64 pg.
VI. Om Rødspætteyngelens aarlige Indvandring i Limfjorden etc. 1897. 49 pg. 1 Kort. 2 Tabeller.
VI. The Yearly Immigration of young Plaice into the Limfjord etc. 1897. 48 pg. 1 Chart. 2 Tables.
VII. Plankton-Studier i Limfjorden. 1897. 23 pg. 1 Kort. 4 Tabeller.
VII. Plankton-Studies in the Limfjord. 1897. 23. pg. 1 Map 4 Tables.
VIII. Om et Skovl-Vaad til Undersøgelse af dybere Farvande. 1898. 24 pg. 10 Figurer.
VIII. An Otter-Seine for the Exploration of Deeper Seas. 1898. 24 pg. With 10 Figures.
IX. Travlinger i Skagerak og det nordlige Kattegat i 1897 og 98. 1889. 56 pg. 1 Kort.

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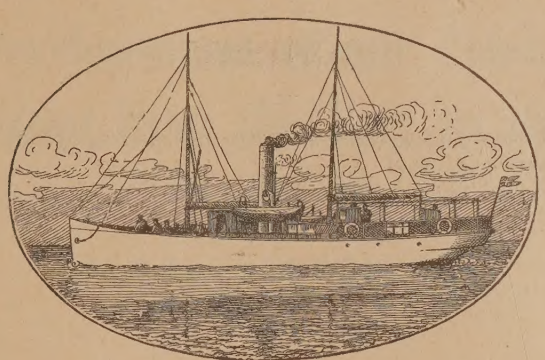

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On the Developement of our Common Gobies *(Gobius)* from the Egg to the Adult Stages etc.

With 1 Plate and 3 Figures in Text.

By

C. G. Joh. Petersen.

The recent valuation investigations have necessitated a renewed study of the biology of some of the commonest species among our smaller fish, viz, the Gobies *(Gobius)*, these creatures being, in many of our waters, so markedly predominant both in number and mass as to play an extremely important part in furnishing nourishment for other fish, etc.

As far back as 1890 and 1891, when the Biological Station first commenced operations, I daily encountered numbers of our three (or four) gobies, and also succeeded in finding their eggs, deposited upon objects on or at the bottom. I was thus in a position to describe these, with illustrations, in Report No. II from the Danish Biological Station (see also Vid. Med. Nat. Foren. 1891) and it was seen that they might easily be distinguished one from another. A newly hatched larva of *Gobius niger*, some few days old, was also illustrated there. In these publications, I took *Gobius microps* and *Gobius minutus* as two distinct species, since there seemed to be a difference even in the eggs, as well as in the young stages and adult specimens; the general opinion among later writers, however (Heincke, Holt) is that these differences are not of a specific character, and as far as my experience goes at present I am inclined to agree with this view.

By the three common gobies therefore, I understand *Gobius niger*, *Gobius Ruthensparri* and *Gobius minutus* (inclusive of *Gobius microps*).

With regard to the adult, or at least postembryonal stages of these three species, I may observe that they can as a rule be distinguished by means of the following table:

	1st dorsal fin	2nd dorsal fin	No. of vertebræ
Gobius niger	6 rays	12—14 rays	28
G. minutus	6(7)»	10—12 »	30—33
G. Ruthensparri	7 »	10—12 »	32

The seven rays in the first dorsal fin of *G. minutus* are only very rarely found. In *G. Ruthensparri*, the eyes face directly out to either side, not obliquely upward as in the two other species, and on the base of the caudal fin there is a large dark pigment spot, which may be imagined as divided by a horizontal line into an upper and a lower half, both symmetrical. A similar spot in *G. minutus* on the other hand, is irregular, i. e. the lower portion differs in shape from the upper.

In *G. niger*, the distance between 1st and 2nd dorsal fin is very slight; the 2nd dorsal extends far out on to the tail; in grown up males, the tips of the rays reach out beyond the caudal peduncle.

One distinguishing character between these species I should like to point out, as it has not hitherto been noticed, viz; that the rays of the first dorsal in fairly grown up *G. niger* are set at about equal intervals, save that the distance between the 5th and 6th rays is slightly greater than between the others. Or possibly we may say, that the interval between the rays increases gradually from the 1st to the 6th ray. In *G. minutus*, on the other hand, the 5 first rays are set at equal intervals, while the 6th is at a considerable distance from the 5th (see Figs. 11—12 on the Plate). In *G. Ruthensparri* the first 6 rays are set at equal intervals, the 7th being farther from the 6th. (Figs. 17 and 18).

G. Ruthensparri is said to have at times 6 or 8 rays in the 1st dorsal fin; I have never met with any instance of this.

With a little practice, fairly grown up specimens of these three species may easily be distinguished one from another, but many fruitless attempts have been made to find a method of distinguishing between the young; it is only in this present year that I have succeeded in doing so.

E. Ehrenbaum, writing in 1905—1909 of »Eier und Larven von Fischen des nordischen Planktons« stated with regard to *Gobius Ruthensparri* »Die Larven sind bisher nicht beschrieben und sind denen von *G. minutus* wahrscheinlich sehr ähnlich«. For *Gobius niger*, he reproduces my earlier figure of a fairly recently hatched young with dorsal spot; his other figures can, we may say, only be determined as belonging to this species by the lesser number of vertebræ, and the same applies more or less to the greater number of vertebræ in his three figures of *Gob. minutus*.

Not until the visit of Dr. Reinhard Gast to the Station in 1915 did we realise that among the many thousand specimens daily brought on board with the Zostera leaves, there were two types, one having an unbroken line of black pigment spots on the spinal column, extending from the region of the anus to the caudal peduncle; the other with three separate pigment groups on the same part. The fish are, when alive, transparent at these stages, which are abt. 8—16 mm long. That these two types must, having a great number of vertebræ, represent *Gobius Ruthensparri* and *G. minutus*, we did not doubt; but what about the young of *G. niger?* This fish had throughout the summer deposited its eggs on all clean objects which we had hung out from the station on the bottom for the purpose, and the males exhibited a most touching care in guarding the eggs, so that neither crabs, starfishes nor other intruders might devour them. But where were the young? They should have been easily discoverable in quantities close by. The station was then at Nyborg, in the inner portion of the fjord (Dyrehavekrogen) and the young ought to be recognisable in the older stages from the lesser number of vertebræ. All our efforts to find such young were fruitless; a few developed bottom stages of 2,5 to 4 cm length may be disregarded. We searched the Limfjord, the Isefjord, the Sound, the Great Belt, etc., but all in vain; only once, on the 24 July 1915, did Dr. Gast find, in the station well, some few small pelagic young of a peculiar type with 28 vertebræ, which he rightly considered should be ascribed to *G. niger*. The question was, however, not followed up that year, but in 1916, the matter was kept in view whenever opportunity arose, and finally all stages of developement were found. Cand. H. Blegvad,

the Assistant at the Station, and I, examined from time to time the many young Gobies which were found especially each morning in the station well, a reservoir with free access for the sea water built into the vessel exactly in the manner of the well in an ordinary fishing smack. Thus we gradually became well acquainted with the younger stages of the two types mentioned; the very youngest stages were also procured, as also of *Gobius niger*, by hatching the eggs naturally found in the sea. Towards the end of July and throughout the whole of August we found, on some days, when certain winds prevailed, more or less considerable numbers of a third type, in which metamorphosis took place at a slighter length than in the two former; it had 28 vertebræ, and evidently belonged to *Gobius niger*. At the same time we had searched the bottom at many places for the metamorphosed stages of this type, but for a long time found nothing but a very few of that year's young, until one day, the 26th August 1916, cand. Blegvad, investigating a very restricted area on the western side of Slipshavn (in the outer part of Nyborg Fjord) with a small seine made of stramin, found some 50 specimens ranging from abt. 10 mm to abt. 20 mm, all bottom stages. This spot is up to the present the only place I know where they are to be found in any quantity at this season. The pelagic stages I have as a rule only found in the well at the station; searching for them in the water above the Zostera, where the two others are common, is usually fruitless. It must be left for future investigations to ascertain the habitat of the young of *Gobius niger*, now that we already know them in all stages; I would call to mind, however that Ehrenbaum u. Strodtmann (Eier und Jugendformen der Ostseefische. I. Bericht. Helgoland. Wiss. Meeresunt. VI. Bd. ausgegeb. 1904 p. 108) state that on a terminal cruise in the Baltic in August 1905 they found young pelagic Gobies, which from the slight number of vertebræ must be all ascribed to *G. niger;* they were encountered in quantities in the open western Baltic, less abundantly east of Bornholm. This may doubtless be taken as indicating that the young of *Gobius niger* live, as a rule in other places than the young of the two other species, or at least not together with them. The point will have to be further studied, if we are to obtain correct knowledge of the biology of *Gobius niger*, and it will be worth while doing so, since the species abounds in our most closed fjords, and serves both as food for the fishes and bait for the fishermen, especially on eel and cod hooks; for this latter purpose hundreds of thousands are used annually.

I will now proceed to describe the young of the three *Gobius* species, pointing out however, at the same time, that both scale limits and pigmentation are as a rule subject to so great variation as to be useless for purposes of distinction between larger specimens; we have nevertheless good specific characters in the number of vertebræ and number of fin rays. In quite young individuals, on the other hand, the occurrence of »embryonal pigment« is an important feature.

I know few products of nature which are so beautiful to look at as the living young of *Gobius*, when newly caught, with the wealth of form and splendour of colour which they reveal. It was therefore much to my regret that I had to relinquish the idea of giving illustrations of the handsome creatures in all their finery; the reproduction would have been too expensive, and even then not equal to nature. I must console myself with the fact that most other investigators never

see all this magnificence, for the young are caught for the most part in nets, dragged through the water behind a ship, and then bottled away in some preserving liquid or other for subsequent investigation, when the splendour has disappeared. At the Station, on the other hand, we were able, by means of the well above mentioned, to observe the quite small specimens alive in the water, to catch them carefully, and place them living under the microscope. I contented myself therefore with keeping the young in weak formol for later treatment; by this process they lose their fine colours, only the black pigment remaining. This is, however, with the shape, number of rays and number of vertebræ, sufficient for distinguishing between them, and in museums and collections the gobies are often as a rule even poorer as regards preservation.

I. The small, newly hatched young of all 3 species are shown on the Plate I, Figs. 1, 7 and 13. Those of *G. minutus* are distinguished at this stage by a large, highly ramified chromatophore at the lower edge of the tail; *G. niger* has a somewhat similar one, though with less ramification, while *G. Ruthensparri* again has no very marked chromatophore in the long series which in all three species runs along the lower edge of the tail to near the swim bladder. Another, shorter row of chromatophores is found in all three species from the anus to close beneath the yolk, which is not yet absorbed; this last row is, in *G. niger,* less unbroken than in the two others; it contains fewer chromatophores, and is in particular interrupted slightly in front of the anus, continuing again under the yolk.

G. minutus has a small chromatophore on the upper side of the tail above the large ramified one on the lover; *G. Ruthensparri* has a similar one, and as a rule also one farther forward nearly above the anus; these two species have in addition a median pigment spot inside the head beneath the auditory vesicles, but this is lacking in *G. niger* at these young stages; possibly always.

II. Soon after the yolk is absorbed, and the young are large enough to be taken in a free state, *G. niger* is seen to have developed a pigment spot on the upper side of the tail above the large chromatophore on the lower side, but *G. Ruthensparri* loses its upper caudal spot (see Figs. 2 and 14); *G. minutus* on the other hand suffers no essential change, and is therefore not illustrated here. The chorda end is not yet curved up.

III. When the true rays of the caudal fin are visible, and the metamorphosis of the tail almost at an end (see Figs. 3, 4, 8, and 15) *G. niger* has the upper caudal spot augmented, the lower caudal chromatophore has little to destinguish it from the others, *G. minutus* has developed several highly ramified caudal chromatophores, both upper and lower, but *G. Ruthensparri* has still no upper caudal pigment, only a close unbroken series on the lower edge of the tail and a very intermittent row in front of the anus. At this stage the number of vertebræ can be determined; *G. niger* has 28, the others 30 to 33.

IV. In the fourth stage we find, at a length of abt. 9 mm in *G. niger* (not shown here, owing to lack of good preparations) and at a slightly greater length in the two others, vertebral pigment on the caudal vertebræ and not in the integement (see Figs. 9 and 16); in *G. Ruthensparri* this makes a continuous series reaching to above the anus, but in *G. minutus* it forms three groups of spots, the row being interrupted in two places. Somewhat similar is

the case with *G. niger,* but this fish is now so developed that we can already distinguish its heavier form, the low number of vertebræ, numerous rays in second dorsal fin, etc., so that there is no risk of confusing it with either of the two others. *G. niger* passes over into the bottom stages at abt. 10—12 mm (see Fig. 5) and resembles in all essentials the young fully metamorphosed fish (see Fig. 6).

V. The two other species however, have as a rule at a length of abt. 11 mm still not attained their full number of rays in the first dorsal; *G. minutus* sometimes not even at 14,3 mm (Fig. 10); it has only 5 rays, and thus still lacks one, and both species have undergone further change (se Figs 10 and 17). *G. minutus* has now developed a quantity of caudal pigment; there are four large groups along the upper side of the tail, one large spot on the peduncle, this being however, already indicated in earlier stages, and three large groups along the median caudal line, which now cover the three earlier groups of vertebral pigment, these being now only just visible below. *G. Ruthensparri* has also developed four large pigment groups along the upper side of the tail, a spot on the peduncle, and some slight integumental pigment along the median line of the tail, but its unbroken series of vertebral pigment is distinctly visible beneath.

On comparison with Figs. 11, 12 and 18, which should best be called bottom stages, — if indeed it be proper to speak of such at all in the case of *G. Ruthensparri* with its highly natatory existence — we notice how the spots of the young gradually disappear, giving place to the colour pattern of the grown up fish; observe for instance that the peduncular spot in *G. Ruthensparri* may, as already mentioned, be divided horizontally into two symmetrical parts, whereas the lower portion in *G. minutus,* at all stages down to 7 mm length, is noticeably larger, and in particular more irregular, running out over the lower rays of the caudal fin. This is a good distinguishing mark between these two species in many young, and as a matter of fact also grown up stages.

The figures in the plate do not claim to show all details in the appearance of the gobies; thus for instance the small, often almost invisible embryonal pectoral fins are found in all stages, even those just hatched, but are here often omitted, when their outline was not distinctly visible. The rays of the other fins are not always given in their full number; when these were too difficult to discern, the fins were drawn as they appeared in the preparation. The drawings are for the most part to be regarded as habitus figures, drawn, it is true, under the prism, but with particular attention to features serving to distinguish the species when small, especially the pigmentation. Nevertheless, a great deal more has doubtless been correctly included in the figures. All that I chiefly aimed at here was to distinguish between the young of these three species, so that their biology might thereafter be more closely studied.

Where living material is available — and the stages over 5 mm may easily be procured with suitable implements of stramin — distinction is further facilitated by the more perishable yellow and red pigment. The young of *G. niger* have, up to as much as 9 mm, only black pigment and a pale yellow tinge diffused over the whole of the body; *G. minutus* has at abt. 5—6 mm both pale yellow and black chromatophores, though the black ones appear greyish, being more

ramified than in *G. niger; G. Ruthensparri* has in addition, at 5—6 mm, red chromatophores especially on the ventral part. It is remarkable, however to note the change which can take place in the whole appearance of these young fish when placed in a white bowl; the chromatophores then contract, and the habitus of the fish is very markedly altered. This applies, of course, to all young fish; still, I think that it is more pronounced than usual with these. Care is therefore necessary, or one may easily be deceived with specimens thus transformed.

My main object with these investigations was to familiarise myself with the young of *G. niger,* which are of so great importance to our fishermen. And in this I also succeeded. In addition, two other types of young were distinguished, belonging to *G. Ruthensparri* and *G. minutus (microps);* the only *Gobius* species common in the Great Belt at Nyborg. In the case of *G. minutus,* the only doubt there can be is as to whether it comprises two species, *G. minutus* and *G. microps,* or one only; this question is not yet altogether solved, and cannot be until highly detailed studies have been made, based upon numerous countings of vertebræ etc. That there are two forms, a smaller with 30—31 vertebræ, *G. microps*, and a larger one from deeper, more open water, having as a rule 33 vertebræ, is beyond all doubt; with regard to the heredity of these types, however, I know absolutely nothing, and can only say that intermediate forms between the two seem to occur, wherefore I have here treated them as one species. Young fish from shallow water appear to differ from those found in deeper water both in pigmentation and in the length at which metamorphosis takes place; it was however, no part of my plan to go farther into this question here.

With regard to the genera *Aphya* and *Crystallogobius,* the latter is so rare in the Great Belt that there can hardly be any grounds for fearing confusion; I have only once, in the deepest part of the Belt, found a young of this species. *Aphya* is more common, but these fish are so slightly pigmeted, that they are hardly likely to be taken for *Gobius; Aphya* for instance entirely lacks the black pigment on and in the head (only a couple of spots on the throat, at the clavicula end) along the whole of the dorsal side, along the entire length of the spinal column. *Aphya,* moreover, may reach a length of no less than 19 mm before the permanent rays of the pectoral fins are developed (Collett), whereas in *G. niger,* this takes place at a length of only abt. 9 mm; it is this species, with which there would otherwise be most reason to expect confusion, as *Aphya* generally has 27 vertebræ and *G. niger* 28, so that mistakes might occur; as it is, however, the pigmentation of head and dorsal part in *G. niger* preclude all possibility of its being taken for *Aphya.*

Of the true gobies, *G. scorpioides* is doubtless too rare to be of any importance and is, moreover, not known from Nyborg; *Gobius pictus* was the one I found most reason to suspect, this being stated by Winther as taken at Kallebod Strand (Nat. Tids. 3. R. 9. Bd. 1874 p. 218—219) but he marks it himself with a large query. The find is based on a colour sketch of a single specimen, since lost, and on reading Winther's record, which gives, *inter alia,* »spots on the dorsal fin dark brownish«, i. e. not black, which was hitherto the best known character of *G. pictus,* I came to the conclusion that it cannot have been a *G. pictus* which he described; *G. pictus* has moreover, never since been found in the

Sound, but several specimens are known from the Kattegat (Hirtsholmene, Læsø, Anholt), off the coast of Samsø, and down in the northern parts of the Great Belt (Elefantgrunden); always in fairly open water. In the case of this species also, there was thus little reason to fear that the young could play any important part among our more important gobies, unless indeed I should completely have overlooked also the grown up specimens of *G. pictus* among the coastal forms of *Gobius* in the Great Belt. This possibility led me to go further into the matter both by examination of material from the Zoological Museums of Copenhagen and Christiania, and also from my own collections since 1901; I take this opportunity of thanking both Museums for the material kindly sent, which has, as will be seen from the following, been of some importance to the proper comprehension of the question.

I have for many years been somewhat disinclined to accept *G. pictus* Malm as a truly distinct species; among other reasons, on account of the poor preservation of the specimens in our Danish Museum; they were for the most part collected by myself many years back, and have somehow or other become very much bleached; in addition, all published descriptions indicate the species as very difficult to distinguish save by the velvet-black pigment series on the dorsal fin.

Holt and Byrne (Report on the Sea and Inland Fisheries of Ireland for 1901. App. No. III. The British and Irish Gobies.) mention this difficulty; but in their fine work, the species is still maintained as such. The pigmentation in Gobies is however, a dangerous field, being extremely variable, and my investigations were therefore directed towards the discovery, if possible, of other distinctive specific characters than this. My efforts were for a long time fruitless, until one day, on examining one of the Norwegian specimens determined by Collett, I discovered, that the posterior side of the pectoral fin presented, even under a low power lens, a highly peculiar appearance, see Fig. 1. p. 11. Along the fin rays, especially the

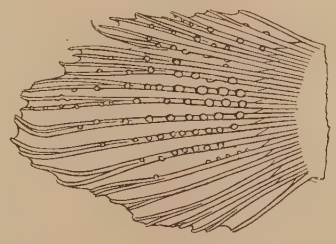

Fig. 1. *Gobius pictus.* Left pectoral. Posterior side.

longest ones in the middle and above, rows of small processes were visible, giving the fin a remarkable appearance of roughness, a thing I had never noticed in any other *Gobius.* These processes were however, not found in all specimens. On going through my later material from the Kattegat, I found similar processes in many of the individuals which, according to their pigmentation of the dorsal fins, were identified as *G. pictus,* whereas in a large female with ova, and many smaller individuals, this peculiarity was lacking; I suppose therefore that it is confined to grown up males. On further examination of mature specimens belonging to the nearest related form, *G. microps,* nothing corresponding was found, only under

the microscope could I discern a single small process on one of the the fin rays, but absolutely nothing like the arrangement seen in *G. pictus*.

I now began to believe in the existence of *G. pictus* as a species, but wished to find some better distinguishing features, applicable at least to all grown up specimens. I particularly studied the first dorsal fin in *G. pictus* and *G. minutus (microps)* see Fig. 2 p. 12, and found black pigment in both, but the

Fig. 2. *Gobius pictus* and *Gobius microps*. 1st dorsal.

two rows of really velvety black spots, with the largest spot behind the sixth ray, I found only in *G. pictus*. In the other species, the chromatophores only collect in the vicinity of the sixth ray, and chiefly on the anterier side of the same, to a real black spot, though this is often lacking; otherwise they are so scattered that the spots can only be called grey. Even these characters, however, I considered insufficient, as they can only be discerned with difficulty, if at all, in young specimens; I therefore examined the number of vertebræ. I knew that Holt and Byrne (l. c. p. 38) had stated — although without attaching any great importance to the fact — that *G. pictus* has 28 vertebræ, while they give 30—32 for *G. minutus* and 27—28 for *G. niger;* and I was further aware that Ehrenbaum (Nordisches Plankton. Eier und Larven von Fischen. I p. 94—95) gives 29 vertebræ for a *G. pictus* taken at Helgoland, whereas his figures for *G. minutus* are 32—33. If this low number of vertebræ, 28—29, held good, it would furnish a good distinctive character for comparison with *G. microps*, which has more.

I therefore examined several specimens of *G. pictus* from Norway with this end in view, and found that they had 30 vertebræ; of seven individuals from Nordre Rønner (Læsø) six had 30 and one 29, but the Danish *G. microps* can also go down to 30, though as a rule they have 31. I have never, however, found 29 in any specimen, though I have examined some thirty of these. Thus, although the numbers of vertebræ in *G. pictus* and *G. microps* may in some degree be said to overlap, I nevertheless consider it certain that the former has as a rule fewer than the latter, which suggests that we have here really a distinct species; this is, moreover, further indicated out by the pigmentation of the dorsal and by the processes on the pectoral fin of the grown up males. In cases where the pigment really was visible and well preserved, I have never seen a transition form to *G. microps*, and must therefore regard *G. pictus* Malm as a true species.

As regards the eggs of our gobies, the four species or varieties differ in shape, as I have already pointed out long since in Report II; the four different forms are here reproduced:

Fig. 3. 1. *Gobius niger*. 2. *Gobius Ruthensparri*. 3. *Gobius minutus*. 4. *Gobius microps*.

For *G. pictus*, both Holt and Ehrenbaum describe the ova as pear-shaped and very similar to those of *G. microps;* this gives us therefore no aid to distinction of the species. Ehrenbaum, however, writes (l. c. p. 95) of *G. pictus:* »Die Larven sind 2,68 mm lang und haben gelbe und schwarze Chromatoforen, die sich in fast ununterbrochener Reihe an der dorsalen wie an der ventralen Körperkontur bis fast zur Schwanzspitze hinziehen.« If there be really an unbroken series of black chromatophores along the dorsal side of the fish, then we have here a further evidence that *G. pictus* is a distinct species; possibly, however, the words are not to be thus interpreted.

A. Appelløf, writing in Bergens Museums Aarbog for 1891, No. 1 p. 9—10, mentions the eggs of a Gobiid from the inner side of a *Chætopterus* tube, which he believed belonged to *Crystallogobius;* in shape they resemble the eggs of *Gobius niger*. They are subsequently shown in the Aarbog for 1896 No. 3 p. 10, by James A. Grieg; they were 1,2—1,5 mm long, and 0,4—0,5 mm broad.

Appelløf also mentions, l. c. p. 10, in a note, some eggs of another Gobiid, not answering in shape to any of those shown by *Petersen;* they could therefore not be determined.

Holt's observations l. c. p. 57 as to the eggs of *G. scorpioides's* appear very vague.

The eggs of *Aphya* would seem to be entirely unknown, as also those of the gobies living in deeper water.

The entire species question: *Gobius minutus, microps* and *pictus,* might well deserve to be made the subject of special investigations based on a large amount of material; it is doubtful, however, whether such would carry us much farther, as the question of heredity will still remain unsolved.

As regards distribution, there is distinct difference between the three, *G. minutus* going out into deeper water than the other two; *G. microps* again, seeks the most landlocked bays, while *G. pictus* prefers more open water.

The mass of literature dealing with young stages of fish includes various drawings of young *Gobius,* which are more or less difficult to distinguish, and sometimes incorrectly identified. I have no desire to go through all these and quote the places of publication, but think it right to make an exception in the case of two which have found their way into Mc Intosh and Masterman, British marine Food fishes, 1897, Pl. VII. Fig. 3 appears to be that of a correctly identified *Gobius minutus,* but Fig. 5 has certainly nothing to do with *Gobius niger,* the swim bladder is not sufficiently black, and the remainder of the body too brown in the pigment, lacking also the characteristic few black spots found in *G. niger*. Ehrenbaum has (l. c.) already called attention to this.

In investigations of this and others of similar nature, a method of great importance is the colouring of the calcified parts of the specimens, e. g. with Alizarine. The fish are first coloured in abt. 70 % alcohol, tinged to a yellowish or brownish hue with Alizarine, then placed in absolute alcohol, and thence transferred to Zylol; they then become transparent, and all parts can as a rule be counted, provided they have not previously lain too many months, or possibly years, in preserving liquid. From the Zylol, they may be again transferred to Canada balsam and fixed between glass slips.

It was Professor Dr. H. Jungersen who first made me acquainted with this colouring method, for which I am extremely obliged. The quite small stages lose a good deal of their shape in the process, especially through the action of the Zylol, but they can also be transferred directly from the absolute alcohol to Canada balsam.

Note. For greater convenience in further investigations on Gobiidæ, the figures for number of vertebræ as found by Ehrenbaum (E.), Holt (H.) and Petersen (P.) are here given. The figure in parentheses indicate the number of specimens examined.

		Rule
Gobius niger 28, E. & P. (some), 28—27 H. (2)	28	Vertebræ
— *microps* 31 (6), 30 (4) P.	30—31	—
— *minutus* 33 (8), 1 with one vert. rudimentary (P)	33	—
— *Ruthensparri* 32 (c. 14) P.	32	—
— *pictus* 30 (9), 29 (1) P., 28 (3) H., 29 (1) E.	28—30	—
— *scorpioides* 26 (1) P.	26	—
— *paganellus* 28—29 (4) H.	28—29	—
Aphya pellucida 27 (abt. 10) P.	27	—
Crystallogobius Nilssonii 29—30 E., 30 (some) P.	29—30	—

Although the actual figures will, on investigation of further material, doubtless be found to overlap even more than is here shown, the table yet furnishes some aid to the determination of these fish; possibly, again, the overlapping would be less when dealing with specimens from one and the same locality.

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Winther, Georg: Om de danske Fiske af Slægten *Gobius*. Naturh. Tidsskr. 3. R. 9. Bd. 1874. pg. 191—226; with continuation l. c. 3. R. 11. Bd. 1877—78, pg. 41—56.

Explanation of Plate I.

Figures 1—6 of *Gobius niger:*

1. Just hatched on board; the yolk is discernible beneath the swim bladder. Length 2,5 mm. Nyborg. 5—7—16. The black upper caudal spot is not found.
2. Taken in the well on board. Nyborg. 18—8—1916. Length 4,5 mm. The black upper caudal spot has now appeared.
3. Taken in the well on board. Nyborg. 14/15—8—1916. Length 7 mm.
4. Taken in the well on board. Nyborg. 14/15—8—1916. Length 9 mm. Permanent rays of the pectoral fin already visible.
5. At Tidselholt (Great Belt) 24—8—1916. Length 12 mm. The fish now living on the bottom, and metamorphosis practically completed.
6. At Nyborg. 25—8—1916. Length 20 mm. Note position of the rays in 1st dorsal; 2nd dorsal has 14 rays. Fish living on bottom.

Figures 7—12 of *Gobius minutus* incl. *microps.*

7. Just hatched on board; the yolk discernible beneath the swim bladder. Length 2,6 mm. Nyborg. 1—7—1916. Note the flat median pigment spot under the auditory organs.
8. Taken in the well on board. Nyborg. 16—8—1916. Length 7 mm.
9. Taken in the well on board. Nyborg. 16—8—1916. Length 10,8 mm.
10. Tidselholt (Great Belt) 24—8—1916. Length 14,3 mm. Rays in the pectoral fin still very short, recently appeared.
11. Tidselholt (Great Belt). 24—8—1916. Length 20 mm. Note that the 6th ray in the first dorsal fin is far removed from the 5th. Best described as a bottom stage of a fully metamorphosed fish.
12. Holckenhavnsnoret near Nyborg. 9—8—1916. Bottom stage. Length 27 mm.

Figures 13—18 of *Gobius Ruthensparri.*

13. Just hatched on board; the yolk indicated, and median pigment under the auditory organs. Two upper caudal spots. Length 2,2 mm. Nyborg. 1—7—1916.
14. Taken in the well on board. Nyborg. 28/29—8—1916. Length 5,8 mm. The black upper caudal spots have disappeared. Unbroken row of pigment from head to anus.
15. Taken in the well on board. Nyborg. 28/29—8—1916. Length 9 mm. No. of vertebræ over 30. Upper caudal spots lacking. Living with red, black and yellow chromatophores.
16. Taken in the well on board. Nyborg. 28/29—8—1916. Length 10,8 mm. Unbroken vertebral pigment series found on the tail. Pectoral fin indistinct.
17. Taken in the well on board. Nyborg. 29—9—1916. Length 15,5 mm. Transition stage. Rays of the pectoral fin visible. 7 rays in first dorsal.
18. Hvidegrunden in Nyborg Fjord. Length 25 mm. Metamorphosis practically complete.

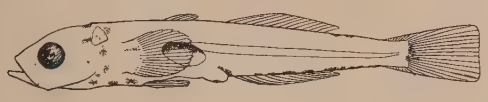
Gobius.

1. 2,5 mm

2. 4,5 mm

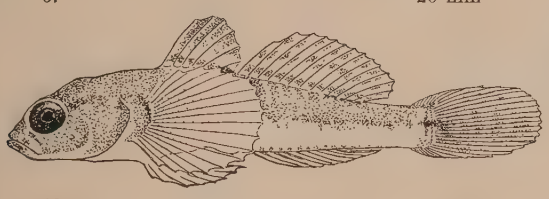
3. 7 mm

4. 9 mm



5. 12 mm

6. 20 mm

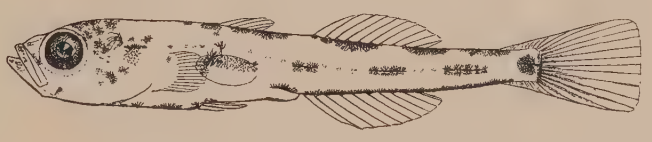


7. 2,6 mm

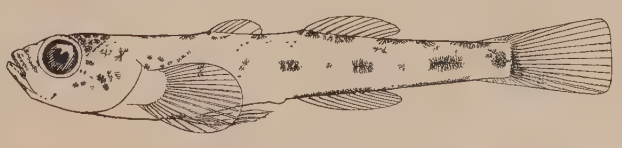
8. 7 mm

9. 10,8 mm

10. 14,3 mm



11. 20 mm



12. 27 mm

13. 2,2 mm

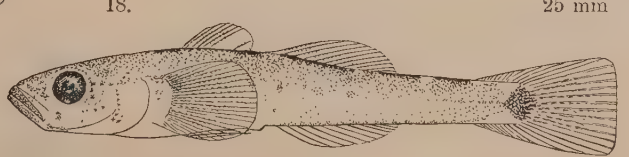
14. 5,8 mm

15. 9 mm

16. 10,8 mm

17. 15,5 mm

18. 25 mm



Westergaard del.

On the Food of Fish in the Danish Waters within The Skaw.

By

H. Blegvad.

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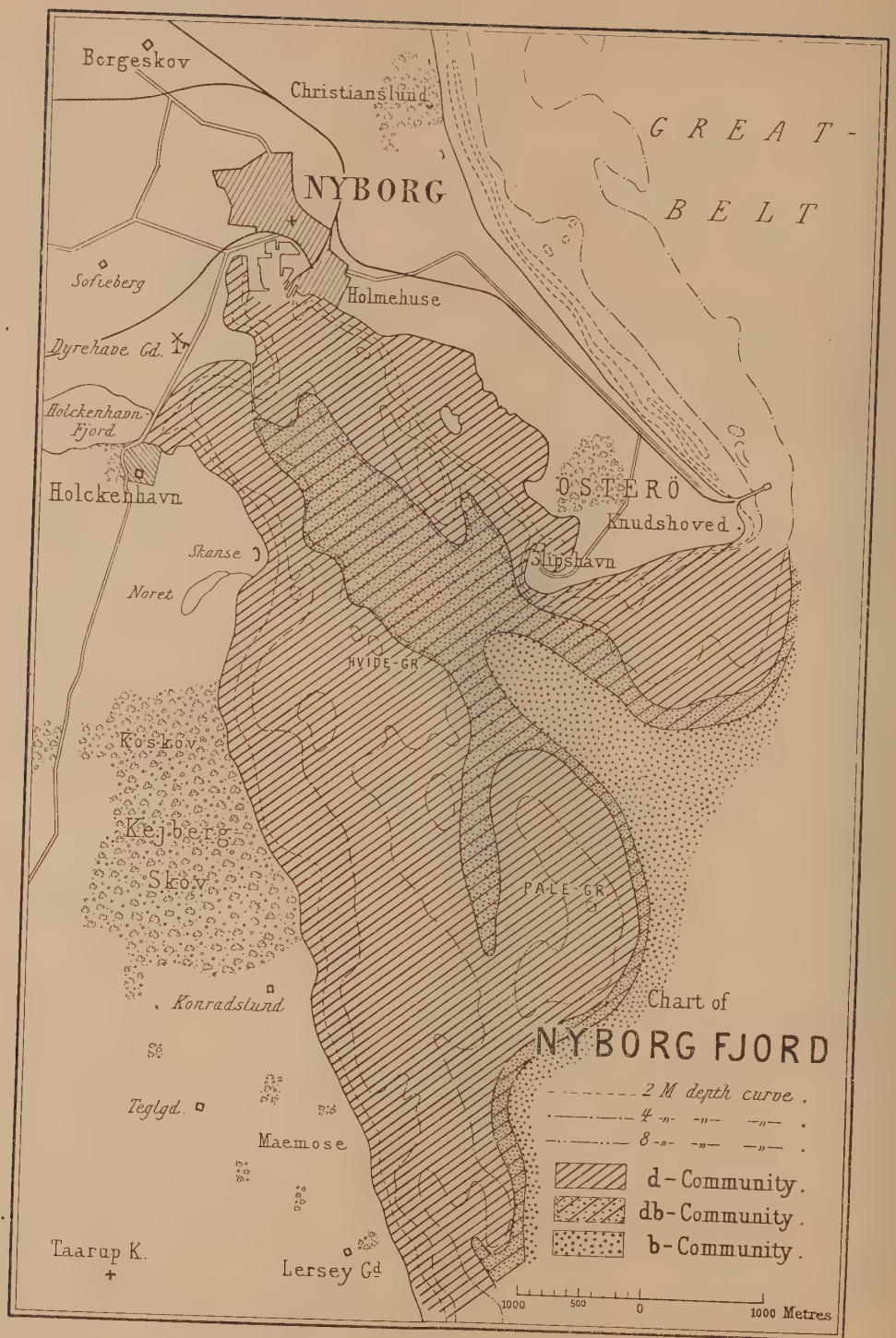
Introduction.

The Danish waters contain a bottom fauna which, as has been shown by Dr. Petersen in Reports Nos. XX, XXI and XXIII from the Danish Biological Station (1911, 1913 and 1915 respectively) groups itself naturally into communities, where certain particular species of animals absolutely predominate over all others. Dr. Petersen has divided up the bottom organisms of the Danish seas (especially the Invertebrata) into some half-score animal communities, which he has named according to the species predominating in each, the »character forms« (see Report XXI p. 4 ff.); and has further drawn up charts showing the distribution of these various communities. With regard to Fishes, the present investigations have shown that many of them are associated with certain particular animal communities, inasmuch as they seek their food in preference from among certain species of the bottom fauna. Numerous fishing experiments have shown, that a locality with a given community of bottom fauna invariably proves to be the haunt of particular species of fish; some fishes, such as the eel and many small fish, are found only in connection with a single community; others, such as for instance the cod, may be encountered among several such. I purpose therefore, in the present paper, which is based mainly upon the investigation of freshly caught material on board the Biological Station's s. s. »Sallingsund« from 1899—1915, to give a brief account of the more important lower organisms in each community, for comparison with the contents of stomach actually found in fish living on the communities in question. I may commence with the animal communities in our fjords and coastal waters, and first of all, as being best known to us, those of Nyborg Fjord and adjacent waters.

Nyborg Fjord. Nyborg Fjord is a typical representative of many Danish fjords; cutting fairly deep into the land, open to the sea, and consequently with comparatively salt water (abt. 1,5 %); depth on the whole but slight, 500 out of the total 1800 ha. of the fjord being less than 5 m, and the remainder only from 5—15 m to bottom. A broad belt of vegetation runs along the coast, extending out to abt. 5 m depth; the predominant plant is the *Zostera*, here and there, however, replaced by *Fucus*, *Ulva*, or other algæ. It is this plant belt which


Borgeskov
Christianslund
GREAT-
BELT
NYBORG
Sofieberg
Holmehuse
Dyrehave Gd.
Holckenhavn Fjord
Holckenhavn
ØSTERÖ
Knudshoved
Skanse
Slipshavn
Noret
HVIDE-GR
Koskov
Kejserg-
Skov
PALE GR
Konradslund
Teglgd.
Maemose
Taarup K.
Lersey Gd
Chart of
NYBORG FJORD
2 M depth curve.
4 -»- -»- -»- .
8 -»- -»- -»- .
d-Community.
db-Community.
b-Community.
1000
500
0
1000 Metres

forms the home of the richest fauna in our fjords. The water among the leaves is crowded and teeming with small crustaceans, molluscs and small fish, which again afford a richly furnished table for many of our food fish, especially the eel. Outside the plant belt, on the »bare« grounds, the fauna is far poorer.

Nyborg Fjord contains three kinds of animal communities (see accompanying chart). In the shallowest parts, also including the entire plant belt, we have the »*Macoma*« or *d*-community, the character species of which is *Macoma baltica*, with various attendant species, to be subsequently mentioned, differing according to the nature of the bottom. On the soft ground midway out in the fjord, the predominant species is *Abra alba*, the character form of the »*Abra*« or »*b*« community, which extends out beyond the mouth of the fjord over great tracts of sea bottom in the Belt waters. By way of transition between these two communities, we have in Nyborg Fjord an area where both character species occur, and which may therefore be termed the »*db*« community. The fjord, as reckoned to the line Knudshoved—Palegrunden—Lerseygaard, is divided up between these communities as follows: the *d* community abt. 1350 ha., the *db* community abt. 320 ha., and the *b* community abt. 100 ha.

I. The Macoma community.

A. The bare strand zone.

Commencing with the *Macoma* community, we find, nearest the shore, a narrow strip of sandy and stony bottom having no fixed vegetation, or practically none, save for the microscopical layer of algæ upon stones, wooden piles, etc., the action of the waves here preventing the plants from gaining permanent foothold. Within this narrow zone, a great part of which is often left dry by the ebb, we find an »on«-fauna or epifauna: *Littorina rudis* f. *tenebrosa*, *Littorina littorea*, *Mytilus edulis*, some few Balani and *Acmæa testudinalis*. Beneath the stones may be found at low water *Nereis diversicolor*, *Naidæ*, *Gammarus*, *Idothea* and *Iæra*, with large *Cardium edule* and *Mya arenaria*. Somewhat farther out, however, where the bottom is not left dry every day, and where the richer deposits of detritus often render it softer, there are, besides the above mentioned bivalves, numbers of *Macoma baltica* and *Scrobicularia plana*; *Hydrobia* may be seen swarming over the sand, the excrement heaps thrown up by *Aricia armiger*, *Nereis diversicolor*, and especially *Arenicola marina* cover the bottom, *Mysidæ* swim about in shoals, and in summer, the three- and ten-spined sticklebacks, and *Gobius minutus*, roam about hunting for copepods, pelagic gastropod- and lamellibranch-larvæ, and Mysidæ. The sticklebacks (*Gasterosteus aculeatus* and *G. pungitius*) are the first to venture into this shallow water in the spring (in April); not until May does *Gobius* come in, to deposit its eggs on empty Mya shells etc. The goby will never move from the eggs, even though the water recede so far as almost to leave the bottom dry; on one such occasion, when the ebb was very marked, I was actually able to photograph a *Gobius minutus* guarding its eggs under a Mya shell; the sand round about was dry, leaving only a little water in the tiny hollow under the shell. The Gobius,

however, heedless of danger to its own life, kept faithfully waving its pectoral fins so as to send a constant supply of fresh water over to the eggs, stuck under the shell, and dashed out furiously against all intruders venturing to approach the precious charge. Save for these two small fish, predatory animals are very rarely found in this extremely shallow water. An occasional crab may be seen prowling about after Hydrobia or Mysidæ. The *Littorina littorea*, which otherwise mainly lives on vegetable diet, (here the green algal slime on stones, piles, etc.) may at times take a sudden fancy to ostracods and quite small larvæ of Mytilus or Hydrobia, and finally, there are as a rule a few Asterias among the large bunches of Mytilus, sucking out the mussels one by one. On the whole, however, the bare strand zone may be said to be a preserved tract, where *Nereis diversicolor*, *Arenicola*, *Littorina*, *Mytilus*, *Cardium* and *Mya* occur in great masses, among them large and well developed specimens, often of a great age.

In the spring, a sudden rich growth of *Ulva lactuca*, *Ectocarpus*, and a few other filiform algæ may take place in this bare zone. But the Ulva is soon torn away from its hold, to drift about at the surface, full of air bladders, and much the same applies to the other algæ. They are thus of no permanent importance as food for the fauna here, but doubtless furnish a considerable amount of nourishment in the form of fresh plant food and decaying fragments (detritus).

The bare strand zone thus contains a *Mya-Cardium-Arenicola* facies of the *Macoma* community, with *Littorina*, *Mytilus* and *Balanus* etc. as attendant epifauna. To give an idea of the quantity — at times enormous — of these animals per unit of area, the following weights per 1 sq. m. sea bottom are quoted, from Nyborg Fjord and the waters south of Sealand respectively.

Depth 1 m. Bottom-sampler.	Nyborg Fjord, at Holckenhavn weir. $^{13}/_{9}$ 1912.		At Guldborg Ferry E. Dug up. Dry at ebb tide. $^{26}/_{5}$ 1911.	
	No.	Rough weight in gr.	No.	Rough weight in gr.
Macoma baltica	30	7,0	42	13,0
Mya arenaria	820	36,0	26	113,0
Cardium edule	80	8,0	9	8,0
Mytilus edulis	3580	18500,0		
» » juv	380	70,0		
Littorina littorea	140	132,0		
Nereis diversicolor	80	20,0	3	0,5
Arenicola marina			70	141,0
Gammaridæ	220	11,0		
Total per 1 m² gr...		18784,0		275,5

We have here, then, a great mass per sq. m. but the animals weighing most, *Mytilus*, *Mya* and *Littorina littorea*, are perennial, so that the annual production of meat in proportion to the mass is comparatively slight; the fact that they are allowed to remain and grow old however, in itself shows that they are

here left more or less at peace. Of *Mysis* (mostly *M. flexuosa*) we have in this shallow water at a single haul with a young-fish-seine, a »Not«, covering 70 sq. m. of bottom, taken 800 specimens to a rough weight of 36,5 gr. (August 1915).

B. The plant belt.

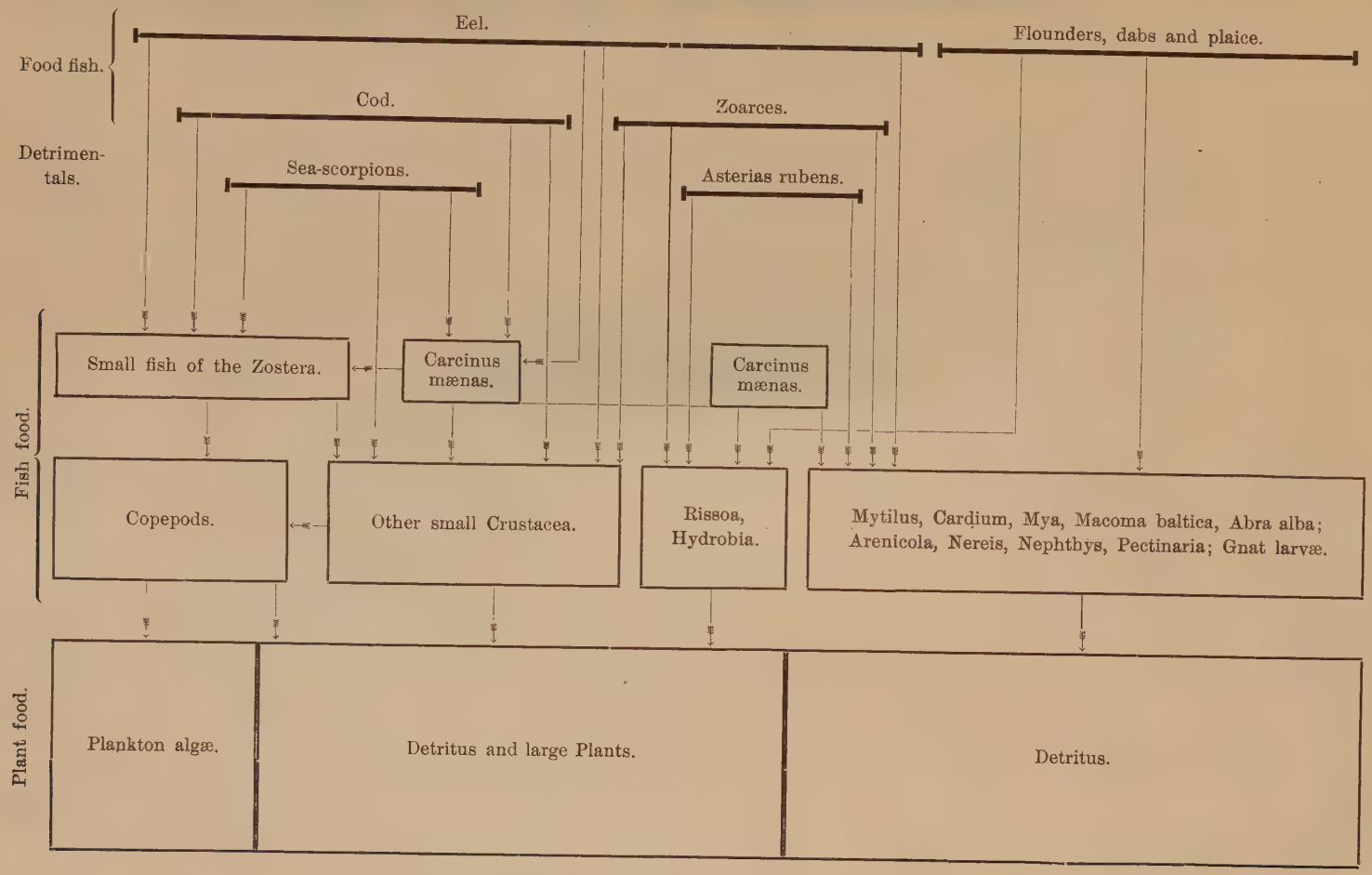
Passing from the bare ground out into the plant belt, we find the actual bottom fauna (the »In-fauna«) unchanged; the »epi-fauna« however, attached to objects above the bottom now consists almost exclusively of small gastropods, first and foremost the 2 species of *Rissoa*, *R. membranacea* and *R. inconspicua*, and in addition *Lacuna divaricata, L. pallidula, Littorina obtusata* f. *fabalis, Odostomia* and *Cerithium reticulatum*. The Zostera is the most important plant; it shelters, besides the mentioned small molluscs, which sit close and thick on its leaves, also quite small *Mytilus edulis*. As the leaves of the Zostera live but a comparatively short time (a couple of months at the outside), and the mussels are attached by their byssus threads to these, all are as a rule less than 2 months old. On the deeper Zostera, the young of *Asterias rubens* may likewise be found adhering to the leaves, where they feast themselves upon these small Mytilus and Rissoa. How many of these small creatures are annually devoured by young Asterias it is impossible to say, but it will easily be realised that the quantity must be great, when we mention the finding, in Nyborg Fjord, on 1 sq. metre bottom, of 53 young Asterias clinging to the Zostera leaves. Another dangerous enemy to the small Mytilus and Rissoa is the crab, which has a clever trick of gathering up several Zostera leaves together so as to make a climbing-stalk capable of bearing its weight.

In addition, however, we find among the Zostera plants quantities of the small crustaceans which are so important to the fish; *Idothea* (*I. baltica* is the most common), several species of Gammaridæ, Mysidæ, (mainly *M. flexuosa* and *M. inermis*), *Palæmon Fabricii*, and finally the copepods, of which several species are found

At the red light, Nyborg Fjord.
2 Metres depth. Long *Zostera*. 25. August 1915. Hand net over 1 m².

	No	Rough weight in gr.
Cardium sp. juv.	2	0,02
Modiolaria sp. juv.	2	0,02
Mytilus edulis juv.	5	0,02
Rissoa membranacea	84420	126,7
» inconspicua		
Littorina littorea	28	7,9
Lacuna pallidula	19	0,2
» divaricata	18	0,3
Gammarider	14	0,1
Mysider	67	0,7
Idothea baltica	3	0,1
Crangon vulgaris	1	0,2
Palæmon sp.	1	1,1
Asterias rubens	7	2,0
Ctenolabrus rupestris juv.	1	0,1
Gasterosteus aculeatus juv.	1	0,2
Syngnathus typhle	1	0,1
On 1 m² total gr.		139,76

Food of Fish and principal Animals in Nyborg Fjord: schematized.



among the minor algæ with which the Zostera itself is always, and more particularly in summer, overgrown. Among the roots of the Zostera we find practically the same animals as in the bare strand zone. Some idea as to the relative quantities of the different animals belonging to the epifauna of the plant belt may be gained from the catch made with a fine-meshed hand net run through the Zostera in Nyborg Fjord over an area of 1 m². (List p. 23).

From this List, which may be taken as a typical example of the epifauna found in the plant region of Nyborg Fjord at this season, it will be seen that the small gastropods, more especially the two Rissoa species, are, in the mass, absolutely predominant over all the other animals. The fish found here, are, as will be seen from the list p. 24, partly food fish, such as eel, flatfish, cod and viviparous blenny; partly detrimentals, viz; the sea scorpions, and finally, the useful small fish in the Zostera, to wit, the gobies, sticklebacks, fifteen-spined sticklebacks, pipe-fish and wrass.

1. Food of the small fish in the Zostera.

In the Zostera live the three *Gobius* species: *Gobius minutus*, *G. Ruthensparri*, and *G. niger*. The first-named lives, here as in the bare strand zone, on copepods, both pelagic forms *(Calanoida)*, and forms keeping to the bottom or to the vegetation *(Harpacticoida)*; also on small crustaceans such as *Gammaridæ*, *Idothea*, *Mysidæ* and small *Crangon*; in a single instance I have further found young *Mytilus*, *Cardium* and even a Terebellide in the contents of stomach, but the crustaceans make up by far the greater part (see the list for *Gobius minutus*[1], which contains

Gobius minutus. 18 investigations, comprising 106 spec. in all, length 1—7 cm, depth 0,5—16 m.													11,45 gr. Fish	
No. of specimens.	Not weighed:												Weighed: 22.	
	3.	21.	1.	20.	4.	2.	3.	2.	1.	5.	2.	20.		
Mytilus edulis juv.	..	..	..	..	..	..	1/8	..	1/8					
Cardium edule juv.	..	..	..	..	..	..	1/8							
Mollusc larvæ	..	..	..	..	..	..	..	..	..	1/2	..	..	0,02	0,02
Hydrobia sp. juv.	..	..	..	..	..	..	..	..	..	..	2/3			
Artacama proboscidea	..	..	..	1/8										
Gammaridæ	..	1/8	..	1/8	1/2	..	3/4	1/1	..	..	1/8	1/4	0,13	
Idothea sp.	..	..	..	..	..	..	..	..	2/3	..	..	1/4	0,02	
Mysis mixta	..	..	..	1/8										0,26
» flexuosa	..	1/8												
» spiritus	1/1													
» sp.	..	..	1/1	..	1/2	..	..	..	..	..	..	1/4	0,11	
Crangon vulgaris	..	3/4												
Calanoida	..	..	..	..	..	1/1								
Harpacticoida	..	..	..	..	..	..	..	..	..	1/2	..	1/4	0,02	0,02
													Total stomach content gr....	0,30
													Proportion of rough weight of stomach content to weight of body...	(1/38)

[1]) For information as to lists, see p. 72.

results of investigations from the Kattegat coast, Snekkersten, Grønsund, the Fjords of Nyborg and Svendborg, Kallundborg and Odense Fjords, the Isefjord and the Limfjord.)

Gobius Ruthensparri lives chiefly upon copepods, both the pelagic ones and those attached to the vegetation; as also pelagic mollusc larvæ; the newly hatched Gobius-larvæ, — they emerge from the egg in July-August — live almost exclusively on these small animals, but as they grow up, devour in steadily increasing quantities first small crustaceans, especially larvæ of *Mysidæ, Gammaridæ, Iæra* and *Idothea,* then larger specimens of the same and small worms (e. g. *Harmothoë*) and in the largest *Gobius Ruthensparri* one may even find now and again a small *Mytilus edulis* or a small *Rissoa,* though such cases are exceptional. The chief food is 1) copepods, especially pelagic, 2) larvæ of small crustaceans, and 3) pelagic mollusc larvæ. The list here given (p. 27) includes results of investigations from the Kattegat coast, Snekkersten, various parts of Samsø Belt, the Great and the Little Belt, as also the Limfjord and the Isefjord.[1])

Gobius niger, the large black goby, resembles in manner of life more Zoarces than the other fish in the *Zostera,* living, as does the former, upon 1) small crustaceans, especially *Idothea* ($^1/_3$ of total weighed contents of stomach) *Gammaridæ, Mysidæ, Proto* and *Corophium;* in this it resembles, it is true, *Gobius Ruthensparri,* but in contrast to the latter, it selects for preference the larger and grown up specimens of these Crustacea, and can even swallow young of the common shore crab, *Carcinus mænas*; it also feeds on 2) small lamellibranchs and gastropods, e. g. young *Cardium* and *Mytilus, Macoma baltica* and *Alba alba, Rissoa* (both *R. membranacea* and *R. inconspicua*) with *Cerithium,* 3) insect larvæ and

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[1]) By the kind assistance of the well known copepod specialist, Dr. C. With, Rigshospitalet, a number of copepods from the stomach contents of *Gobius Ruthensparri* and *G. minutus* and from the surface plankton, all from Nyborg Fjord, were determined.

1. Stomach contents of young *Gobius Ruthensparri* and *G. minutus.* $^{20}/_8$ 1915:
   Temora longicornis ♀ ad.
   Centropages hamatus Lilj. ♂ ad.
2. Stomach contents of *Gobius Ruthensparri.* $^1/_9$ 1915:
   Greater part: *Paracalanus parvus* Claus ♀ ad. also young specimens.
   Fairly numerous: *Oitona.*
   Some few: *Temora longicornis.*
   Here and there remains of *Harpacticoida* (weed forms).
3. Surface plankton. $^{20}/_5$ 1915:
   Some few specimens of *Oitona* and *Paracalanus parvus.*
4. Surface plankton. $^{20}/_9$ 1915:
   Predominant mass: *Oitona sp.* (♂; ♀ with egg sac).
   Abt. 20 *Paracalanus parvus* Claus.
   Some few *Acartia longiremis* Liljeb.
5. Plankton. $^{18}/_{11}$ 1915:
   The sample, consisting mainly of *Peridinea* and algal chains contained also numerous *Oitona, Acartia longiremis* and a single specimen af *Paracalanus parvus.*

It will thus be seen that the bulk of the stomach contents in the gobies examined consisted of copepods from the surface plankton, and of just those very species which may be taken with a fine plankton net by drawing it through the surface of the water; there were also, however, some few copepod forms from the weed vegetation in the stomachs of the adult gobies.

Gobius Ruthensparri.

44 investigations, comprising 777 spec. in all; length 1,1—5,2 cm, depth 1—8 m.

138,4 gr. Fish.

No. of specimens.	Not weighed: 9.	3.	5.	10.	2.	3.	2.	10.	10.	6.	10.	16.	10.	10.	6.	21.	109.	5.	10.	5.	20.	5.	5.	Weighed: 485.	
Mytilus edulis juv.	..	..	..	..	..	..	..	..	..	1/4															
Mollusc larvæ	+	..	..	..	..	..	..	1/2	..	..	+	..	..	..	..	1/4	2/5	1/4	..	1/2	1/3	..	..	0,29	0,29
Gastropoda juv.	..	..	..	..	..	..	..	..	..	1/4															
Harmothoë imbricata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,01	0,01
Gammaridæ	1/10	..	..	1/2	..	..	1/2	..	..	1/2	..	..	1/2	..	..	..	1/5	1/2	..	+	..	..	..	0,22	0,36
Idothea sp.	..	..	..	..	..	..	1/2	..	..	..	..	..	..	..	..	..	1/5	..	..	..	..	..	..	0,06	
Mysidæ	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,07	
Iæra marina	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,01	
Isopoda	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+					
Ostracoda	..	..	..	..	..	..	..	..	..	..	..	1/10	..	..	..	..	..	..	..	..	..	..	..	0,16	2,88
Cladocera (Bosmina?)	..	..	..	..	..	..	..	..	..	..	1/2	..	..	..	1/4	..	..	..	..	..	..	..	..	0,02	
Calanoida	9/20	..	..	..	..	..	..	..	..	1/2	9/10	1/2	1/1	3/4	3/4	..	1/4	..	1/4	2/3	1/1	1/1		2,60	
Harpacticoida	9/20	1/1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/10	..	1/1	1/4	..	..	..	0,10	
Copepoda	..	..	1/1	1/2	1/1	1/1	..	1/2	1/1																
Insect larvæ	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/10								

Total stomach content gr....	3,54
Proportion of rough weight of stomach content to weight of body...	(1/39)

Polychæta; even Polychæta so large as *Arenicola, Nereis* and *Nephthys* are devoured. Finally, they can also eat 4) other small fish, such as *Gobius Ruthensparri* and *G. minutus*. Last summer (1915), at Bramsnæs Vig, Isefjorden, 91% of the stomach content in 31 *Gobius niger* examined was found to consist of the soft parts of *Mytilus*, easily recognisable from the characteristic feet with byssus threads. As to how the fish can be imagined to extract the soft parts from the shell of *Mytilus*, frequently large specimens, I shall have occasion to refer to this later, when dealing with similar finds in the case of other fish. Meanwhile, the list p. 28 may be consulted; the investigations here are from Samsø Belt, various parts of Nyborg and Svendborg Sound, south of Sealand, the Limfjord and Isefjord.

The two species of stickleback, *Gasterosteus aculeatus* and *G. pungitius* are both found in the *Zostera* region of Nyborg Fjord; their manner of life resembles in many respects that of *Gobius Ruthensparri*. When the young emerge from the egg in the spring, they at once set about a keen hunt for copepods *(Calanoida)*, *Cladocera* and mollusc larvæ, as also weed copepods, *(Harpacticoida)* and *Ostracods*; as they grow up, they begin to take, in addition, larvæ of *Gammaridæ*, *Idothea* and *Mysidæ*. *Iæra, Corophium,* insect larvæ, and even adult winged land insects, which in summer are often found in crowds covering the waters of our fjords; in most cases it is probably the wind which has carried these small creatures too far out from terra firma, leaving them to their fate in the watery element as a helpless prey to the greedy sticklebacks. As a further proof of the voracity of these small fish may be mentioned that at the season when the conifers spread

Gobius niger. 44 investigations, comprising 452 spec. in all; length 4—14 cm, depth 0,5—12 m.	4893,6 gr. Fish.	
No. of specimens.	Weighed: 452.	
Abra sp.	14,50	32,65
Macoma baltica	1,20	
Cardium sp.	0,30	
Mytilus edulis	16,65	
Rissoa sp.	4,47	9,87
Cerithium sp.	0,90	
Lacuna sp.	0,10	
Philine aperta	1,00	
Acera bullata	3,40	
Nereis sp.	1,46	10,75
Nephthys sp.	0,80	
Arenicola marina	2,00	
Priapulus caudatus	6,40	
Polychæta	0,09	
Ophioglypha albida	0,20	0,20
Insect larvæ	3,54	3,54
Gammaridæ	12,40	71,73
Mysidæ	1,74	
Idothea sp.	55,59	
Proto sp.	0,50	
Carcinus mænas	1,50	
Gobius Ruthensparri.	8,60	19,10
» minutus	10,50	
Detritus	2,66	3,06
Zostera and Algæ	0,40	
Total stomach content gr.	150,9	
Proportion of rough weight of stomach content to weight of body	($^1/_{32}$)	

their fine pollen dust abroad, the stomachs of sticklebacks may be found quite distended with this dust, which can often be seen in the spring as a fine, pale yellow powder covering great stretches of our home waters near the shore. The eggs of other species of fish, or even of other sticklebacks, they will also devour with great voracity. The list of stomach contents includes, for *Gasterosteus aculeatus*, investigations from the Kattegat coast, Snekkersten, Samsø Belt, Great and Little Belts, the islets south of Sealand, and the Isefjord, as also Nykøbing Bay, Mors. (See List p. 29.)

The list for *Gasterosteus pungitius* gives results of investigations from Odense and Nyborg Fjord, Svendborg Sound, Stege, Grønsund, Nykøbing Bay, Mors, and Holbæk Fjord. (See list p. 30.)

Of the Pipefish, *Syngnathus typhle* is by far the most common species in Nyborg Fjord; the little *Nerophis ophidion* is rarer, and rarest of all is the fine large form *Nerophis æquoreus*, which only appears in these waters as a visitor.

Gasterosteus aculeatus.

57 investigations comprising 736 specimens in all, length 0,2—11 cm, depth 0,5—8 m.

835,2 gr. Fish.

No. of specimens.	Not weighed:																										Weigh. 427.	
	31.	5.	10.	5.	6.	2.	4.	10.	14.	1.	2.	10.	10.	2.	1.	4.	4.	3.	2.	20.	88.	10.	10.	10	14.	20.	10.	1.		
Mytilus edulis juv.	..	..	..	..	..	..	1/4																							
Pelagic lamelli branch larvæ	1/20	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/16	..	..	1/8	..	..	0,08	0,08
Gastropods juv.	..	..	..	..	..	..	1/4																							
Pel. Gastropod larvæ	1/20	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/16	..	..	1/8	..	..	0,05	0,30
Gastropod eggs	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,25	
Polynoidæ	..	..	..	..	..	..	..	..	1/10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,23	0,28
Spionidæ	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,05	
Terebellidæ	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/1										
Tanaidæ	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,30	11,79
Iæra marina	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,64	
Gammaridæ	..	..	..	..	..	..	1/2	1/5	..	1/1	1/2	..	1/1	..	..	1/3	1/4	2/3	1/2	..	1/20	1/2	..	..	..	..	..	..	0,81	
Crustacea	..	..	..	..	1/1																									
Idothea sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/2	1/3	..	..	..	..	1/20	1/2	..	..	2/25	..	..	..	0,32	
Mysidæ	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/3	..	..	..	..	..	..	..	..	..	..	..	..	9,72	
Copepoda	..	1/1	2/3	..	..	1/1	..	..	..	..	1/4	..	..	..	..	..	..	..	1/2	..	..	..	..	..	1/50	..	..	1/2	0,18	10,85
Calanoida	9/20	..	..	..	..	..	..	..	..	..	..	1/2	..	..	..	..	..	1/3	..	..	..	..	3/4	1/1	..	3/4	1/1	..	5,92	
Harpacticoida	9/20	..	..	..	..	..	..	2/5	..	..	..	..	1/1	..	..	..	..	..	..	..	2/5	..	..	..	..	..	..	..	1,61	
Ostracoda	..	..	1/3	..	..	..	..	1/5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,19	
Cladocera	..	..	..	..	..	..	..	..	..	..	1/4	..	..	..	..	..	..	..	..	..	..	..	1/8	..	..	..	..	..	2,95	
Winged Insects	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1,16	2,27
Insect larvæ	..	..	..	..	..	..	..	1/5	..	..	..	1/2	..	..	1/2	..	3/4	..	..	..	2/5	..	..	..	..	..	..	..	1,11	
Ophioglypha albida	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,10	0,10
Appendicularia	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,10	0,10
Actinia viduata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,20	0,20
Gobius sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9/10					
Pelag. young Fish	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,50	2,25
Fish eggs	..	..	..	1/1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/10	..	..	..	..	..	..	..	1,75	
Pollen of Conifera (Fir?)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,08	0,28
Algal threads	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/2	0,20	
Detritus	..	..	..	..	..	..	..	..	9/10																					

Total stomach content gr.... 28,5
Proportion of rough weight of stomach content to weight of body... (1/29)

Syngnathus typhle is a distinctly predatory fish, only when young contenting itself with small food such as copepods and ostracods; otherwise, it feeds for the most part on other small fish, especially young *Gobius Ruthensparri* and sticklebacks; next in order being *Mysidæ*. The investigations noted in the list are from Nyborg and Holbæk Fjords, Little Belt', Odense Fjord, Isefjord, various bays in the Great Belt, in the Limfjord, and at Hals. (See list p. 30.)

In *Nerophis ophidion* from Nyborg Fjord, as also from Svendborg Sound, I have only found copepods and ostracods, but at Snekkersten and Stege the sto-

Gasterosteus pungitius.

21 investigations, comprising 142 specimens in all; length 2—5 cm, depth 1—6 m. — 57,9 gr. Fish.

No. of specimens.	Not weighed: 5.	2.	1.	2.	2.	1.	1.	1.	3	2.	3.	1.	2.	4.	Weighed: 112.	
Pelagic lamellibranch larvæ	..	..	..	..	..	..	..	..	..	..	1/10					
» gastropod larvæ	..	..	..	..	..	..	..	..	..	..	1/10					
Gastropods juv.	..	..	..	..	..	..	..	..	..	..	..	1/10				
Insect larvæ	..	..	..	1/5	..	..	..	..	..	..	..	..	1/10	..	0,02	0,02
Iæra marina	1/2	..	..	..	..	..	..	..	..	..	..	..	..	..	0,03	0,35
Gammaridæ	1/2	..	..	1/5	..	1/2	1/2	1/4	1/1	4/5	..	..	9/10	1/3	0,32	
Idothea sp.	..	..	..	..	..	..	1/2									
Calanoida	..	1/2	1/2	..	1/2	..	..	1/2	..	..	4/5	4/5	..	1/3		
Harpacticoida	..	1/2	1/2	2/5	1/2	..	..	..	..	1/10	..	1/10	..	1/3	0,48	0,54
Ostracods	..	..	..	1/5	..	1/2	..	1/4	..	1/10	..	..	..	..	0,06	
Eggs of Gasterosteus sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,35	0,35
Total stomach content gr....															1,26	
Proportion of rough weight of stomach condent to weight of body...															(1/46)	

Syngnathus typhle.

55 investigations, comprising 412 specimens in all, length 2—25 cm, depth 0,5—c. 8 m. — 476,3 gr. Fish.

No. of specimens.	Not weighed: 3.	1.	1.	2.	1.	10	3.	6.	3.	2.	1.	1.	10.	2.	3.	1.	2.	20.	5.	2.	1.	1.	1.	1.	4	1.	3.	Weighed: 321.	
Iæra marina	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/2	..	..	..	..	..	..	..	..	0,27	
Gammaridæ	..	..	..	..	..	..	1/2	1/1	..	..	..	1/1	..	..	..	..	..	1/3	..	..	..	..	..	..	..	1/2	..	0,23	
Idothea sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/3	..	..	..	1/2	..	..	..	1/2	..	0,18	
Mysis vulgaris	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/4										5,41
» flexuosa	1/1	..	..	..	..	9/10	..	..	..	..	..	..	..	..	..	..	..	..	1/4	..	..	..	..	..	..	..	..	1,52	
» inermis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2,27	
» sp.	..	..	..	..	..	..	..	..	1/1	1/1	1/1	..	1/5	..	..	..	1/2	1/3	..	1/1	1/1	..	1/1	..	1/1	..	3/4	0,94	
Crangon vulgaris	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/2	..	..	..	..	1/2	..	..	..	..	..		
Copepods	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/1	..	..	..	..	0,10	0,25
Calanoida	..	..	..	..	..	..	..	..	..	..	..	..	..	1/2	..	..	..	..	..	..	..	..	..	..	..	..	..	0,15	
Harpacticoida	..	..	1/2	..	1/1	..	..	..	..	..	..	..	..	1/2	..	..	..	..	..	..	..	..	..	..	..	..	..		
Ostracods	..	..	1/2																										
Gobius Ruthensparri	..	..	..	..	..	..	..	..	..	..	..	..	4/5	..	..	..	..	..	..	..	..	..	..	..	..	..	1/4	8,42	9,97
» minutus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,83	
» sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/1	1/1	..	..	..	..	..	..	..	..	..	..	..	0,12	
Gasterosteus aculeatus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,25	
» pungitius	..	..	..	1/1	..	1/10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..		
» sp.	..	1/1	..	..	..	..	1/2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,24	
Remains of fish	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,11	
Total stomach content gr....																												15,63	
Proportion of rough weight of stomach content to weight of body...																												(1/30)	

Nerophis ophidion. 10 investigations, comprising 21 specimens in all, length 20—27 cm, depth 1—c. 8 m.											**Nerophis æquoreus.** 1 investigation, comprising 4 spec. in all, length 27—50 cm, depth 8 m.
No. of specimens.	Not weighed:										Not weighed:
	1.	4.	1.	1.	1.	4.	2.	1.	1.	5.	4.
Mytilus edulis juv.	..	..	..	..	..	..	1/2				
Rissoa sp.	..	..	..	..	..	..	1/2				
Radula of small gastropods	..	..	..	..	..	..	..	..	1/1		
Crustaceans	..	..	..	..	..	1/1	..	1/1			
Gammaridæ	..	..	..	..	..	..	..	..	..	1/2	
Idothea baltica	..	..	..	..	..	..	..	..	..	1/2	
Mysis flexuosa	..	..	..	..	..	..	..	..	..	..	1/1
Ostracoda	..	..	1/1	..	1/1						
Harpacticoida	1/1	1/1	..	1/1							

Spinachia vulgaris. 39 investigations, comprising 366 specimens in all, length 4—16 cm, depth 1—8 m.																	982,1 gr. Fish.	
No. of specimens.	Not weighed:																Weighed: 237.	
	36.	1.	2.	2.	2.	1.	10.	13.	2.	2.	1.	3.	10.	3.	1.	36.	1.	3.		
Rissoa sp.	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	0,25	0,25
Harmothoë sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/10				
Nereis diversicolor	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,16	0,16
Terebellidæ	..	..	..	..	..	..	..	1/10	..	..	..	..	..	..	..	1/10				
Insect larvæ	..	..	..	..	..	..	..	..	..	1/4	..	..	..	..	..	..	..	1/3		
Iæra marina	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,40	
Tanaidæ	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0,70	
Caprella	1/8	..	..	..	..	..	2/5	..	..	..	..	..	..	..	9/10	..	..	..	0,16	
Gammaridæ	1/4	..	1/1	1/2	..	..	3/5	..	1/1	..	1/3	1/1	1/1	..	..	2/5	1/2	1/6	17,28	38,19
Idothea sp.	+	..	..	..	..	..	9/10	..	..	+	1/1	1/3	..	..	1/10	2/5	..	1/6	9,36	
Mysidæ	..	..	..	1/2	1/1	1/1	..	..	..	..	..	1/3	..	..	..	..	..	1/3	10,29	
Calanoida	+																			
Harpacticoida	..	..	..	..	..	..	..	..	..	3/4										
Ostracoda	..	..	..	..	..	..	..	..	..	+										
Hydroidæ	1/2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/2			
Medusæ?	..	1/2																		
Gobius Ruthensparri	1/8																			
Remains of fish	..	1/2																		

Total stomach content gr.	38,6
Proportion of rough weight of stomach content to weight of body	(1/25)

mach contents included small *Mytilus* and *Rissoa*, as also *Gammaridæ* and *Idothea*. Of *Nerophis æquoreus* I have only examined 4 specimens from Stavreshoved (near Kerteminde) of which again only one had anything in the stomach at all, this consisting of *Mysis flexuosa*. (See list p. 31.)

The fifteen-spined stickleback, *Spinachia vulgaris*, lives almost exclusively on 1) crustaceans: *Gammaridæ, Idothea* and *Mysidæ, Caprellidæ, Iæra* and *Tanaidæ*. It will be seen from the list, that 38,19 gr. of the total stomach contents, 38,6 gr. consisted of such smaller crustaceans. Only occasionally have I also found 2) Polychæta: *Terebellidæ, Nereis* and *Harmothoë*, and always in small quantities. In other waters, viz, at Hals and Trellenæs, an altogether different stomach content was twice found, this consisting of fish remains (including *Gobius Ruthensparri*), *Hydroidæ*, and a mass suggestive of *Medusæ;* these cases are, however, as indicated, quite unique. When young, they devour — as do all other species of fish which I have examined — copepods, both *Calanoida* and *Harpacticoida*. The list of stomach contents includes investigations from the Kattegat coast, Odense Fjord, Great Belt, Little Belt, Samsø Belt, Limfjord and Isefjord, as also the localities above mentioned. (See list p. 31.)

Also the wrass (*Ctenolabrus rupestris*) is first and foremost a distinct crustacean eater, devouring great quantities of *Gammaridæ, Idothea, Caprellidæ, Mysidæ,*

Ctenolabrus rupestris.

34 investigations, comprising 206 specimens in all, length 1,5—15 cm, depth 1—13 m. — 2677 gr. Fish.

No. of specimens.	Not weighed: 1.	1.	2.	1.	8.	5.	4.	22.	8.	1.	2.	3.	Weighed: 148.	
Modiolaria sp.	..	..	..	..	..	..	..	..	..	..	..	..	0,60	4,14
Mytilus edulis	..	..	1/4	..	..	..	..	..	1/8	..	1/1	1/10	3,54	
Lacuna sp.	..	..	1/4	..	..	..	1/6	..	..	..	..	..	4,00	19,60
Hydrobia sp.	..	..	..	..	..	..	..	..	1/16					
Rissoa sp.	..	..	..	..	..	..	1/6	1/2	1/16	..	..	1/10	15,10	
Acera bullata	..	..	..	..	..	..	..	..	..	..	..	..	0,50	
Gastropods juv.	..	..	..	..	..	1/4								
Insect larvæ	..	..	..	..	..	..	..	..	..	1/5				
Gammaridæ	..	1/1	1/4	1/2	1/2	3/4	2/3	..	1/4	..	..	2/5	10,18	43,56
Caprella	1/1	..	..	..	..	..	..	..	..	..	..	..	1,50	
Proto sp.	..	..	..	..	..	..	..	..	..	..	..	..	0,90	
Idothea sp.	..	..	1/4	1/2	..	..	..	1/2	1/4	4/5	..	2/5	28,98	
Diastylis sp.	..	..	..	..	..	..	..	..	..	..	..	..	1,50	
Mysidæ	..	..	..	..	..	..	..	..	1/4					
Crangon vulgaris	..	..	..	..	..	..	..	..	..	..	..	..	0,50	
Gobius Ruthensparri	..	..	..	..	..	..	..	..	..	..	..	..	4,50	4,50
» sp.	..	..	..	..	1/4									
Gasterosteus sp.	..	..	..	..	1/4									
Fish roe	..	..	..	..	..	+								

Total stomach con'ent gr. . . . 71,8

Proportion of rough weight of stomach content to weight of body . . . (1/37)

Crangon and other small crustaceans (amounting to more than half the weighed contents of stomach); we also find, however, as in *Gobius niger*, *Rissoa* and other small gastropods from the *Zostera: Hydrobia, Lacuna divaricata* and *Acera bullata;* young mussels, *Mytilus edulis*, which, like the *Rissoa,* are found in great quantities on the *Zostera* leaves during summer, I have likewise found in the stomach of wrass from Nyborg Fjord. Another small bivalve, *Modiolaria,* living in the same way, was found in the stomach of some of these fish from Vejle Fjord. Finally, remains of other fish, e. g. *Gobius Ruthensparri*, were found in smaller quantities. The list includes investigations from the Kattegat coast, Vejle Fjord, Great Belt, Little Belt and the western Baltic.

A species related to the wrass, *Crenilabrus melops,* which visits Nyborg Fjord in great numbers during summer, but disappears again in autumn, feeds

Crenilabrus melops. 4 investigations, comprising 17 specimens in all, length 2,7—13 cm, depth 1—12 m.	20 gr. Fish.	
No. of specimens.	Not weighed: 10. 3. 3.	Weighed: 1.
Cardium sp.	1/40	
Lamellibranchs sp.	4/25	
Mytilus edulis	.... +	0,6 0,6
Lacuna sp.	1/40	
Gammaridæ	13/100 1/2 1/2	0,4 0,4
Idothea sp.	.... 1/2	
Proto sp.	7/25	
Crangon sp.	3/100	
Polychæta	1/200	
Harpacticoida	..... 1/2	
Bryozoa	1/20	
Insect larvæ	3/40	
Gobius Ruthensparri	19/100	
Gasterosteus sp.	3/100	
Total stomach content gr.		1,0
Proportion of rough weight of stomach content to weight of body		(1/20)

on a similar diet: *Idothea, Gammaridæ, Proto, Crangon,* gnat larvæ, small molluscs and, in a lesser degree, larvæ of *Gobius Ruthensparri* and of sticklebacks (see list of investigations, all from Nyborg Fjord and Kerteminde Bay). The wrass also, in their young stages, feed on copepods.

It will be seen from this survey, as also from the table p. 24, that the small fish in the *Zostera* live for the most part on copepods and other small crustaceans. Only *Gobius niger* and the wrass add thereto, though always in a

lesser degree, the small molluscs of the *Zostera,* thus approaching in manner of life to *Zoarces viviparus*; this however, for practical reasons, I have found it impossible to indicate in the table. The chief food is thus for all small fish, crustaceans from the weed region, but the manner in which they procure this is so characteristic of the different species and differs so greatly as between one and another, that it deserves special mention.

Walking out along a landing stage in one of our fjords on a calm summer day, anyone may, with a little practice, find, in the bare strand zone nearest land, the small sand gobies, *Gobius minutus.* Their colour coincides so exactly with the sandy bottom, that they are difficult to discern, and as if aware of this, they keep perfectly still, resting on the bottom with the sucker-like cup formed by the ventral fins growing together. Thus they remain, until a small copepod, a little *Mysis,* or other tempting object chances to pass close before them; then with a sudden forward spring they pounce on and devour the unsuspecting prey. Passing farther out along the landing stage, to where the bottom begins to show spots of brown and green algæ, or *Zostera,* we may notice now and again a sharp flash in the water, or often many at a time, dissappearing as soon as seen. These are the sticklebacks, hunting about in great shoals among the plants, untiringly searching one clump of weed after another for *Harpacticoida, Gammaridæ, Idothea* and other crustaceans, then darting swiftly to the upper water in chase of a small flock of *Mysidæ*, and finally resorting to the safer and more productive pursuit of pelagic *Calanoida* and the flies or other insects which drift helplessly about at the surface of the water. Then look; here come other shoals: a pretty little brown-speckled fish with a big black spot on the tail; this is the little common goby, *Gobius Ruthensparri.* It does not dash about restlessly up and down in the water, but keeps quietly on the watch among the *Zostera* leaves, hovering almost motionless at the same place in the water by means of the pectoral fins. Suddenly, with a flick of the tail, it is off like lightning — a copepod has met its fate. It is without doubt by the aid of sight, that these little fish hunt the copepods and gastropod and lamellibranch larvæ in the water, despite the almost microscopical smallness of the prey in many cases, as they are always carefully sorted out from the remaining plankton, whatever other animals it may contain. Now and again one may see a *Gobius Ruthensparri* dash in towards a pile or other fixed object, just graze it with the ventral side or the ventral fins, and then as suddenly, with a half turn of the body, dart out from the object again with a forcible stroke; there can be no doubt that this manoeuvre is designed to capture the small *Harpacticoida* which are found in the small algæ on the sides of piles out in the water, where they are an easy prey for the keen-sighted small fish. I have seen a shoal of gobies behaving in this manner for hours, one after another dashing in with the same manoeuvre at a pile driven down into the bottom in the *Zostera* region of Nyborg Fjord. — If the surface is calm, and one has patience enough, one may chance to spy the great black goby, *Gobius niger,* swimming quite slowly, almost as if creeping, along the bottom. The greyish brown colour resembles closely the general tone of the bottom, and the fish may often lie quite motionless, with upturned eyes quietly, but fixedly on the watch for prey; an incautious *Gammarus* or *Idothea*, which has failed to distinguish its mortal foe from the sand on which

it lies, is grasped and swallowed in a twinkling, the goby with a sudden stroke of its tail and great pectoral fins dashing forth with gaping jaws and then, having disposed of the tiny but delicate morsel, sinking quietly down to the bottom once more to wait for the next. This method of capture is shown at its highest degree of perfection by the pipefish. Only with the keenest effort is it possible to distinguish these fish from their surroundings, to wit, the narrow green leaves of the *Zostera;* so thoroughly, indeed, does the outward appearance of these fish resemble that of the *Zostera* leaves, that the tail, which otherwise forms the principal means of motion in most other fish, is here altogether set aside. Only in moments of direst peril will the pipefish curve its long narrow body in convulsive jerks; otherwise, the movement is attained exclusively by means of the fine, transparent dorsal fin, which by imperceptible undulations drives the stiff, but slightly curved body forward at an even rate of speed, when it presents exactly the appearance of a *Zostera* leaf floating down with the current. But woe to the young goby that ventures too near such leaf; his days will be numbered; the seemingly narrow jaws of the pipefish open to an astonishing extent, letting the victim, which one might think too large to pass down the narrow gullet, glide through into the belly, where it may be seen as an oblong distension of the slender body. The wrass and the fifteen-spined sticklebacks, on the other hand, swarm about among the plants, actively searching for their prey, as do the other sticklebacks and *Gobius Ruthensparri.* If fifteen-spined sticklebacks in an aquarium are fed with live, adult *Idothea* or *Gammaridæ,* they will fix their teeth in the head or body of the crustacean and swim about with it in their mouth for a while until it has become exhausted and ceased to move; not until then do the merciless little fish loosen their hold for a moment, only to swallow their prey entirely the next. It would seem as if each had its own special game preserve in the *Zostera;* at any rate, I saw last year throughout the whole of the summer, a *Spinachia,* which was easily recognisable by a marked deformation of the back, continually haunting a certain particular spot in the *Zostera* near the anchorage of the Biological Station in Nyborg Fjord.

Most of the small fish appear to be day feeders, the stomach is generally found empty in the morning. Thus two series of investigations with *Gobius Ruthensparri* from the innermost part of Nyborg Fjord on the 27.—28. August and 30.—31. August 1915, showed as follows:

$^{27}/_{8}$, 10 p. m.; of 30 spec. 22 had stomach and intestines full, 7 empty stomach and full intestine, 1 stomach and intestine empty.

$^{28}/_{8}$, 4 a. m.; of 30 spec. 2 had full stomach and intestine, 9 empty stomach and full intestine, 19 empty stomach and intestine.

$^{30}/_{8}$, 10 p. m.; of 25 spec. 20 had full stomach and intestine, 3 empty stomach and full intestine, 2 empty stomach and intestine.

$^{31}/_{8}$, 4 a. m.; of 50 spec. 2 had full stomach and intestine, 2 empty stomach and full intestine, 46 empty stomach and intestine.

$^{31}/_{8}$, 9 a. m.; of 25 spec. 22 had full stomach and intestine, 3 empty stomach, full intestine.

$^{31}/_{8}$, 12 noon; of 25 spec. 21 had full stomach and intestine, 4 empty stomach and full intestine.

$^{31}/_{8}$, 5 p. m.; of 25 spec. 23 had full stomach and intestine, 2 empty stomach and full intestine.

It will be seen that the contents of stomach in the course of the six hours from 10 p. m. to 4 a. m. passes almost or entirely through the alimentary canal. Of 80 specimens examined at 4 a. m. only 4 had still full stomach and intestine, and these were the largest individuals (all were young fish from 1915); these four gobies had devoured larvæ of *Gammaridæ, Idothea* and *Mysidæ* but not pelagic mollusc larvæ or *Calanoida,* which otherwise formed the staple food. This agrees with what has previously been suggested: that they hunt by sight when dealing with the pelagic copepods and mollusc larvæ; from 10 p. m. to 4 a. m. it was dark (sunset a little after seven and sunrise at five) wherefore the pursuit of these had to be relinquished; only the largest specimens, which had already learned to catch the young of crustaceans in the thick clumps of algæ, were able by good fortune to scrape up a couple of mouthfuls in the course of the night. In order to make certain that the young gobies do not feed on plankton during the night, a new series of investigations was carried out, this time in the outer, more open portion of Nyborg Fjord, at Slipshavn, where the depth also was more considerable. The result arrived at was, as will be seen from the following, the same.

Gobius Ruthensparri:

$^{13}/_{9}$, 5 p. m.; Of 10 spec., 10 had full stomach and intestine.

$^{13}/_{9}$, 9.30 p. m.; Of 20 spec., 16 had full stomach and intestine; 4 empty stomach and intestine.

$^{14}/_{9}$, 4 a. m.; Of 30 spec., 5 had empty stomachs, a little in the intestine; 25 had empty stomach and intestine.

$^{14}/_{9}$, 8.30 a. m.; Of 30 spec., 27 had full stomach and intestine, 3 had a little in the stomach, and empty intestine.

The weighings of the *Gobius Ruthensparri* examined with their contents of stomach and intestines showed the ratio between rough weight of stomach and intestine contents on the one hand, and rough weight of the respective fish on the other to be as follows:

	Inner part of Nyborg Fjord.		Slipshavn.
	$^{27}/_{8}$—$^{28}/_{8}$	$^{30}/_{8}$—$^{31}/_{8}$	$^{13}/_{9}$—$^{14}/_{9}$
At 9½—10 p. m.	$^{1}/_{27}$	$^{1}/_{36}$	$^{1}/_{62}$
» 4 a. m.	$^{1}/_{58}$	$^{1}/_{133}$	$^{1}/_{315}$
» 8½—9 a. m.	. . . . .	$^{1}/_{39}$	$^{1}/_{63}$
» 12 noon	. . . . .	$^{1}/_{58}$	
» 5 p. m.	. . . . .	$^{1}/_{49}$	$^{1}/_{43}$

According to this, then, the stomach of a goby, which at 4 a. m. is practically empty, would as early as 8—9 a. m., or in the course of some four to five hours, be filled with food; the digested matter is immediately replaced by new nourishment, so that the proportion between the quantity of food and the

weight of the fish itself remains more or less constant throughout the day. I have noticed the same thing in the case of *Gobius minutus* and *Gasterosteus aculeatus*. An investigation in Svendborg Sound 29.—30. July 1914 showed contents of stomach and intestine in *Gasterosteus aculeatus* at 4 p. m. as 1/20th; at 12 midnight 1/19th, but at 3 next morning only 1/100th of the actual weight of the corresponding fish; the contents of stomach consisted of pelagic animals: *Calanoida* and mollusc larvæ. In Nyborg Fjord, on the $^{27}/_{7}$ 1915, the contents of stomach and intestine in 20 *Gasterosteus aculeatus* was at 10 p. m. $^{1}/_{21}$ of the weight of body, all stomachs and intestines being full of food; at 4 the next morning all the stomachs were empty, some few much digested remains being still in the intestines. The proportion between this content and the total weight of the fish was $^{1}/_{93}$. It will be seen that these two investigations agree very nicely. The food here consisted partly of *Harpacticoida*, partly *Spionidæ*. The pipefish also, both *Syngnathus typhle* and *Nerophis ophidion*, I have repeatedly found with empty stomachs early in the morning, before daylight. The proportion between weight of stomach-intestine content and total weight of fish was for *Syngnathus typhle* as follows:

Nyborg Fjord,	$^{30}/_{8}$ 1915, 10 p. m.; 15 spec. examined, all stomach and intestine full	$^{1}/_{28}$
	$^{31}/_{8}$ 1915, 4 a. m.; 11 spec. examined, all quite empty	0
	$^{31}/_{8}$ 1915, 12 noon.; 3 spec. examined, all stomach and intestines full	$^{1}/_{32}$
Slipshavn,	$^{13}/_{9}$ 1915, 9.30 p. m.; Of 60 spec., 30 had full stomach and intestine, 12 empty stomach, a little in the intestine; 18 were entirely empty	$^{1}/_{72}$
	$^{14}/_{9}$ 1915, 4 a. m.; 16 spec. examined, all quite empty	0
	$^{14}/_{9}$ 1915, 8.30 a. m.; Of 16 spec., 11 had full stomach and intestine, 5 were empty	$^{1}/_{35}$

This last investigation (from Slipshavn) included only the young of that year, which lived mainly on *Mysidæ*, *Gammaridæ*, and *Calanoida;* the few older specimens taken at the same time, fed only on *Gobius Ruthensparri*, of which a single much digested remainder was found still present in the rectum at 4 in the morning.

As regards *Ctenolabrus rupestris*, *Spinachia vulgaris* and *Gobius niger*, the investigations made showed that here likewise the stomach is often quite empty in the morning before daylight, but this is not always the case. Thus an investigation in Svendborg Sound 29.—30. July 1914 showed the stomach and intestine content of 26 *Gobius niger* at 2—4 p. m. as $^{1}/_{28}$ the weight of body; at 12 midnight, 12 specimens showed only $^{1}/_{33}$, but at 3 a. m. (sunrise just after four) again $^{1}/_{29}$ (15 spec. examined); here then, the stomach and intestines were at least as full in the morning as in the evening, and the fish cannot have fasted during the night. These fish, however, as already pointed out, have a somewhat different diet from that of the other small fish, their chief sustenance being the minor

crustaceans of the weed growth: *Idothea, Gammaridæ*, etc., but also worms, small bivalves and similar creatures living either attached to the plants or buried in the bottom and thus equally well obtainable at night as by day.

The results of the investigations made may thus be summarised as follows; The small fish living on copepods do not feed during the night; their digestive tract is emptied completely in the course of 6 hours. In the morning, six hours suffices to refil it completely, and it then remains more or less constantly filled throughout the day.

Whether these small fish remain altogether at rest during the night is another question; on directing a beam of light down among the leaves of the *Zostera* by night, a number of sticklebacks and *Gobius Ruthensparri* may be seen hurrying about, probably terrified by the light. In all probability, these small fish, which have so many enemies, seek concealment under the leaves of the plants, beneath stones, etc. during the dark part of the night, when they could not in any case go about seeking food.

In winter, all small fish appear on the whole to feed less than in summer. Thus on the $^{18}/_{11}$ 1915, the contents of stomach and intestine in *Gobius Ruthensparri* from Nyborg Fjord amounted only to $^{1}/_{75}$ of the total weight (20 specimens examined) and on the $^{2}/_{1}$ 1914 as low as $^{1}/_{100}$ of total weight (10 spec. examined; both investigations made in the middle of the day) whereas the average obtained from the results of all investigations (see lists p. 27) is $^{1}/_{39}$. In *Syngnathus typhle* on the $^{18}/_{11}$ 1915, the corresponding figures were $^{1}/_{111}$ and on the $^{19}/_{11}$ 1915 $^{1}/_{160}$, the average being $^{1}/_{30}$ (see list p. 30); both these investigations were carried out in Nyborg Fjord, and comprise in all 26 fish, taken in the middle of the day; many further similar instances could be quoted. Many of the small fish, as for instance *Gobius niger* and the wrass, leave the plant belt altogether in winter, but as soon as the sun begins to gleam through the green leaves of the *Zostera*, in March—April, and the crustaceans: copepods, *Gammaridæ* and Mysidæ, liven up and commence pairing, the fish are again seen busily in pursuit. They have now to gather strength preparatory to bringing their own young into the world, and for two at least of these small fish from the plant belt: *Spinachia vulgaris* and *Gobius Ruthensparri*, their circle of life is then at an end; they die off one and all after having deposited their eggs, which they guard with such care and disregard of danger that one might imagine they knew their death to be near, and thought only of using their last strength in the raising of healthy progeny to ensure the further maintenance of the species.

2. Detrimental fish.

The small fish above described, though not directly of value to man as actual food, are yet of great importance in furnishing nourishment for the food-fish. There is, however, in the Danish *Macoma* communities, a fish which is of no use either for human consumption or for that of the food fish, while on the other hand it devours great quantities of small fish, and can therefore only be described as detrimental. This is the common sea-scorpion, *Cottus scorpius*. From the list of stomach contents p. 39 it will be seen, that no less than 394 out of the total weight of 770 gr., i. e. over half, consisted of various small fish; sticklebacks, gobies (both *G. Ruthensparri* and *G. niger*), pipefish, sand-eels, herring and fifteen-spined

Cottus scorpius.

49 investigations, comprising 233 specimens in all, length 0,8—26 cm, depth 0,5—27 m. | 21740 gr. Fish.

No. of specimens.	Not weighed: 1.	8.	2.	1.	3.	2.	20.	5.	Weighed: 191.	
Mytilus edulis	....	....	....	....	....	....	....	....	4,0	4,0
Nassa reticulata	....	....	....	....	....	....	....	....	2,0	2,0
Aphrodite aculeata	....	....	....	....	....	....	....	1/4		
Nereis virens	....	....	....	....	....	....	....	1/2	57,5	57,5
Polychæta	....	....	....	1/1						
Gammaridæ	....	....	....	....	....	....	....	....	24,5	
Idothea sp.	....	....	....	....	1/1	....	....	....	51,5	
Mysidæ	....	....	....	....	....	....	....	....	13,5	
Carcinus mænas	....	....	....	....	....	....	....	....	89,6	301,9
Sthenorhynchus rostratus	....	....	....	....	....	....	....	....	4,5	
Paguridæ	....	....	....	....	....	....	1/1			
Crangon sp.	....	1/4	....	....	....	....	....	1/4	106,3	
Palæmon Fabricii	....	....	....	....	....	....	....	....	12,0	
Anguilla vulgaris	....	....	....	....	....	....	....	....	1,0	
Zoarces viviparus	....	1/2	....	....	....	1/3	....	....	40,0	
Gadus callarias	....	....	....	....	....	....	....	....	15,0	
» merlangus	....	....	....	....	....	....	....	....	8,0	
Gobius niger	....	....	....	....	....	1/3	....	....	39,0	
» Ruthensparri	....	....	....	....	....	....	....	....	64,1	
» minutus	....	....	....	....	....	....	....	....	4,5	
Gasterosteus aculeatus	....	....	....	....	....	1/6	....	....	86,5	394,1
» pungitius	....	....	....	....	....	....	....	....	9,0	
» sp.	....	1/4								
Syngnathus typhle	....	....	....	....	....	....	....	....	21,5	
Spinachia vulgaris	....	....	....	....	....	....	....	....	47,0	
Clupea harengus	....	....	....	....	....	1/6	....	....		
Ammondytes lanceolatus	....	....	....	....	....	....	....	....	56,0	
Fish remains	....	....	1/1	....	....	....	....	....	2,5	
Spicula of Spongiæ	1/1									
Zostera remains	....	....	....	....	....	....	....	....	10,1	10,1

Total stomach content gr.	769,6
Proportion of rough weight of stomach content to weight of body	(1/23)

stickleback; even small cod, eel, Zoarces and whiting. Next after the fish come crustaceans as No. 2, with 300 gr. out of the 770 weighed. In the *Zostera* region it is especially *Idothea, Gammaridæ*, prawns *(Palæmon Fabricii)* and crabs *(Carcinus mænas)* which fall a prey; outside the Zostera, mostly shrimps *(Crangon vulgaris)*. In the Limfjord, the stomach has even been found to contain hermit crabs, picked out of their whelk-shell homes, and in the same water, the large Polychæte worm *Nereis virens* plays a not unimportant part as food for the sea-scorpion. The worm in question is in April found for a short time (doubtless in its mating dress, as an epitochal form) in quantities in the stomachs of the most widely differing species of fish. Only in two cases were molluscs found in the stomach content; a single *Nassa reticulata* in Odense Fjord and a large *Mytilus*

Cottus bubalis.

3 investigations from Samsø Bælt, Nyborg Fjord and Svendborg Sound of 3 specimens, length 12—15 cm, depth 0,5—5 m. | 75 gr. Fish.

No. of specimens.	Not weighed: 1 spec.	Weighed: 2 spec.	
Gaminaridæ	.....	0,10	1,0
Idothea sp.	1/2	0,10	
Mysidæ	1/2		
Carcinus mænas	.....	0,80	
Syngnathus typhle	.....	0,23	0,7
Gasterosteus pungitius	.....	0,47	
Total stomach content gr.		1,7	
Proportion of rough weight of stomach content to weight of body		(1/44)	

in Nyborg Fjord in a sea-scorpion taken in a trap; the remaining investigations cited in the list were from the Kattegat coast, Samsø Belt, Great Belt, Little Belt, waters south of Sealand, the Baltic, Isefjord and Limfjord.

The long-spined Cottus, *Cottus bubalis,* which is far more rare than *C. scorpius,* but may nevertheless be found in Nyborg Fjord, I have only on one or two occasions been able to examine; in all cases, however, the results were exactly the same as for the common form, the stomach content consisting of small fish, crabs and smaller crustaceans.

The sea-scorpions are very greedy fish, often stuffing themselves with food to such a degree that the stomach becomes quite distended; I have found them sometimes with a stomach content amounting to 1/5, or even 1/4 and 1/3 the weight of body, the highest values for this which I have ever found in any fish. On the other hand, they may often be found with quite empty stomachs, although the contents of a full stomach, as will be seen from the following, may take several days to digest. On the 17th April 1915, two sea-scorpions weighing 185 and 225 gr. with greatly distended stomachs, were placed in a closed trap which was tied up to the landing stage of the station, in such a manner as not to touch the bottom, the fish being thus prevented from obtaining food. After the lapse of four days, on the 21st April, they were taken up and the stomachs opened; it was then found that each contained a large Zoarces weighing 40 and 45 gr. respectively, the weight of the sea-scorpions themselves (without contents of stomach) being 130 and 155 gr. respectively. They had thus in the four days lost only 15 and 20 gr. respectively in weight, and the ratio between content of stomach and weight of body was still as 1 : 3,2 and 1 : 3,4, although the loss of weight must first and foremost have been due to diminution of the stomach content. A further proof of the voracity of these sea scorpions is the fact that they at times swallow not inconsiderable quantities of rotten weed etc. Some specimens from Vejle Fjord taken on the 9/5 1912 had their stomachs filled for the most part with remains of

Zostera. The sea-scorpion hunts his prey in a similar manner to *Gobius niger*, first lying pressed close to the bottom, on the look-out, then a sudden stroke of the tail and the great pectoral fins, and the victim disappears through the great jaws. It would seem as if the sea-scorpions are also able to catch small fish at night; I have once, in Svendborg Sound, taken a specimen at 3 a. m. before daylight, and found a perfectly fresh *Gobius niger* in the stomach.

3. Food fish.

We now come to the true food fish, which serve directly for human consumption. I will first take the cod *(Gadus callarias),* as its food very much resembles that of the sea-scorpion (see list 1 at end of book). It is as a rule only while young that the cod are found in the plant region of the *d*-communities, especially during the three first years of life (0, I and II groups). During the first year, they feed to begin with exclusively on copepods; especially *Calanoida;* this applies, for instance, to the pelagic young and the very youngest bottom stages; when somewhat larger, they take larvæ of *Gammaridæ, Crangon* and *Mysidæ, Diastylis* and small polychæta, but as soon as they have reached a length of some 10 cm, they commence to feed also on small fish, such as young gobies. In the second and third years they devour great quantitities of crustaceans; adult *Gammaridæ, Idothea, Mysidæ, Palæmonidæ* and *Crangon,* also crabs, *Carcinus mænas,* but these as a rule only when small and yong, and in addition, a large amount of small fish, sticklebacks, *Gobius Ruthensparri, G. niger, Spinachia,* herring, and young Zoarces. Only very rarely do they also take other food, this consisting at the outside of a few Polychæte worms *(Phyllodoce, Nereis, Nephthys)* or a strand whelk *(Littorina littorea).* At times, in the autumn, great shoals of large cod come in from the north, through the Belts, they penetrate right in to the *Zostera* zone along the coasts, and are there taken in great numbers in traps by the fishermen. These large cod, which are as a rule all over 4 years old, live here on crabs and fish, often large specimens of both; not only small fish are devoured in great numbers, but also large eels, Zoarces and dabs, even young cod, and these fairly large, are not despised as food by these oldsters of the same species. The high figures for crabs and for most small fish from the stomach content investigations in the lists are from such old individuals. The cod is altogether a migratory fish, continually on the move. The young »weed cod« can at times be seen during the day hunting restlessly about in small shoals among the *Zostera* leaves and clumps of algæ, searching every spot for food. They hunt also at night; investigations in Nyborg Fjord $^{13}/_{9}$—$^{14}/_{9}$ 1915 showed, that the proportion between stomach content and weight of body in eight cod at 5 p. m. was $^{1}/_{60}$; at 9.30 p.m., after dark, it had decreased to $^{1}/_{137}$ (33 specimens examined) but by 4 next morning, before daylight, the figure had risen again to $^{1}/_{40}$ (8 spec. examined). The stomachs were thus comparatively fullest early in the morning. It is a well-known fact that cod are voracious feeders, sometimes swallowing fish almost as large as themselves. The highest values for ratio between stomach content and weight of body I found in the youngest specimens, the 0 and I groups, for instance, showing figures such as $^{1}/_{10}$, $^{1}/_{8}$ and $^{1}/_{7}$. Otherwise, the average lies about $^{1}/_{38}$.

One of the most common fishes in the plant region of the *d*-communities

is the viviparous blenny, *Zoarces viviparus* (se List 2). The species previously mentioned seek their food almost exclusively among the small fish and crustaceans of the weed vegetation; Zoarces, on the other hand, although devouring a quantity of small crustaceans, which in List 2 make up almost half the entire stomach content, subsists to an essential degree upon the molluscs found in or on the bottom, or on the leaves of plants, such as *Macoma baltica, Cardium, Mytilus, Modiolaria discors, Rissoa* and *Hydrobia,* likewise various worms, especially *Pectinaria Koreni,* insect larvæ, both the green ones living in the weed, and the red *Chironomide* larvæ which live in the bottom. Finally, some few Ascidians (including *Ciona canina),* and a not inconsiderable amount of vegetable remains, but only a very slight quantity of small fish (abt. $^1/_{35}$th of the weight of content of stomach). Among crustaceans, *Idothea* and *Gammaridæ* are predominant, these two together making up about half the total content. The young of Zoarces eat not only copepods *(Harpacticoida)* but will immediately after birth (at which stage they have, however, already attained the comparatively large size of 4—5 cm) attack *Diastylis,* ostracods, young *Gammaridæ* and *Idothea,* as also young molluscs. Zoarces procures its food by a slow and methodical examination of every weed clump. The observer chancing to come upon one of these fish in search of prey among the *Zostera* will notice that it glides along with a very slow and easy undulating movement close to the bottom. Now and again it will take a great mouthful of weed, whence it might seem to be grazing, so to speak, on the vegetation, this constituting its food; as a matter of fact, however, one may soon discover that the fish, shortly after having taken such a mouthful, ejects the greater part of the vegetable mass, which it has only taken for the sake of the crustaceans and molluscs living thereon. As a rule, they do not succeed in separating the vegetable matter completely from the animal, especially the finest threads of algæ; this will be seen from the lists of stomach content, where we find, that no less than 106 gr. or $^1/_9$th of the total stomach content examined consisted of algæ, remains of *Zostera,* and plant detritus. A further 32 gr. consisted of detritus and sand, evidently swallowed involuntarily together with animals living buried in the bottom, such being found therewith in the stomach content. Zoarces masticates its food very thoroughly; on investigating a portion of the stomach contents by mixing it with clean water, the surface will be found covered with tiny fragments of the empty skeletal parts of small crustaceans; even the small *Rissoa* and *Hydrobia* are as a rule found crushed in the stomach contents. On examining Zoarces in the morning, before daylight, they will be found empty, or at any rate with very little in the stomach. Thus investigations in Nyborg Fjord $^{30}/_7$ 1914 at 12 midnight showed the proportion between stomach content and weight of body in 3 Zoarces as 1 : 75; at 2 next morning the proportion in two others was 1 : 80, but at 3 and 4 in the morning, four further specimens examined were found with stomachs entirely empty. The hour of sunset was then 8.30 and sunrise at 4. Another investigation, Svendborg Sound 29.—30. July 1914, gave the following figures:

$^{29}/_7$, 12 midnight,	1 : 71	(6 specimens examined).
$^{30}/_7$, 3 a. m.	1 : 88	(7 — —).
$^{30}/_7$, 9—10 a. m.	1 : 38	(6 — —).

An investigation at Slipshavn (Nyborg Fjord) gave results as follows:

$^{14}/_{9}$ 1915, 4 a. m. 1:100 (11 specimens examined).
$^{14}/_{9}$ 1915, 8.30 a. m. 1:31 (3 — —).

with sunrise at 5.30. It would thus seem that Zoarces do not feed at night, or if at all, less than during the day.

The Eel, *Anguilla vulgaris* (see List 3), is one of our most important food fish; its true home during the period of growth in our waters is first and foremost the *d*-community of the plant region, where it goes in search of *Idothea baltica*, small crabs, *Gammaridæ*, prawns and shrimps (in List 3, the crustaceans amount to almost half the entire stomach contents) and various worms: *Pectinaria Koreni*, *Arenicola marina*, *Amphitrite* and other *Terebellidæ*, *Nereis diversicolor*, *Spionidæ*, *Echiurus*, *Priapulus*, etc. Also certain fishes, Zoarces, both young and fairly large specimens, sticklebacks, *Gobius niger*, *G. Ruthensparri* and the fifteen-spined stickleback. Besides the fish, eels often eat the roe, as we have frequently had occasion to observe at the Biological Station; nearly every year eels are sent us with stomachs full of the roe of other fish, the senders at the same time enquiring whether the roe is not that of the eels themselves, and thus a proof that eels can spawn in our waters. The Danish fishermen, it should be explained, find it as a rule hard to believe that the eel really should move right out into the Atlantic to spawn, and eagerly grasp at anything which might possibly serve to prove the contrary. In most cases, the roe is found to be that of sticklebacks, sea-scorpions or lumpsuckers *(Cyclopterus lumpus)*. In Nyborg Fjord, the mentioned food material is the most common, and the same will doubtless apply to all other Danish waters with exception of the Limfjord: crustaceans, worms, and small fish form the chief food of the eel. Only in some few cases, and then in but small quantities, have I in Nyborg Fjord also found molluscs such as *Rissoa*, *Littorina littorea* (foot and operculum only) and bivalves, such as young *Mytilus*, and siphons of the large *Mya arenaria* in the stomach; in Isefjord *Macoma baltica*, *Cardium exiguum*, *Modiolaria discors* and *Mya arenaria*, both small *Mya* and siphons of the large. In a small portion of the Isefjord, viz: Bramsnæsvig, the eel appears to have a particular speciality, managing somehow to extract the soft parts of the large mussels *(Mytilus edulis)*; great quantities of such may be found in the stomach contents, neatly picked out from the shells, together with a few smaller specimens of the same species, these latter however, being swallowed shell and all; the shells are slightly crushed. In Bramsnæsvig, the eels also contrive to extract the soft parts of *Scrobicularia plana*, which were found in quantities in the stomach contents, with siphon, mantle, gills etc. sufficiently well preserved to permit determination of species. True, when these large *Scrobicularia* or *Mytilus* were found in the stomach, there was generally very little else, but it can nevertheless hardly be supposed that the eels should be driven by sheer famine to devour the soft parts of large bivalves. The eels in question were, as a matter of fact, in very fine condition, and there was also other food available on the spot, to wit, *Macoma baltica* and *Pectinaria*. The question is then, why the eels in other places do not eat mussels, since these abound practically everywhere in our fjords together with the eels; and further, by what means the eels induce the mussels to open their shells so that the soft parts can be picked out. The first part of

the question I am unable to answer. Only in eels from Visby Bredning have I on a single occasion encountered anything similar, slightly over $^2/_5$ of the stomach contents in a number of eels from there consisting of soft and muscular parts of large bivalves, doubtless also *Mytilus edulis,* but at other times they contained quite other matter. All the eels from Bramsnæsvig however, (some sixty in all) though taken at such wide intervals of time as $^{17}/_6$ 1911, $^{18}/_6$ 1914 and $^3/_6$ 1915, contained practically nothing but soft parts of the two mentioned large bivalves. Otherwise, I have never found the slightest indication of such food in the stomach of eels from other Danish waters than those mentioned. With regard to the latter part of the question, various explanations may be imagined. In the first place, that the eel, finding a bivalve«yawning« might with a sudden thrust insert its pointed snout between the shells and bite through the adductor muscles; one objection to this theory is, however, that a mussel rarely opens its shells more than abt. 1 cm apart, which is too little even for the sharp head of an eel; and again, it is improbable that an eel could bite through both the tough adductor muscles before the intended victim could find time to close its shells, a proceeding which would be distinctly unpleasant for the eel, who would find his head gripped firmly between the two sharp edges. Another possibility is that the eel might be supposed to crush the shells of the mussels between the teeth in its jaws and gullet, subsequently ejecting the fragments; as a matter of fact, however, the span of an eel's jaws is so slight that only small mussels, and nowand again *Scrobicularia* can be considered capable of passing through it whole, not mussels of the size here in question. Moreover, it requires a very considerable degree of force to crush the shell of a large mussel, as I have found by forcing one in between the jaws of an eel and then trying to crush it by pressing the jaws together. Now an eel really has a very strong bite, as is sufficiently evident from the extremely tough siphons of *Mya arenaria* which, as mentioned, have frequently been found in the stomach; nevertheless, it can hardly be supposed that this would suffice to crush the solid calcareous shells of large mussels, though it might in the case of smaller specimens and *Scrobicularia.* The principal objection to this hypothesis however, is the fact that the stomach has never been found to contain a single fragment of the shell of a large *Mytilus*, though the soft parts might be there, and it would certainly seem that if the shells were crushed, a small flake at least from the seat of the adductor muscles would be found adhering. And besides, the quite small *Mytilus* are swallowed with the shells only slightly crushed, and not removed; why then should the eel carefully eject all shell fragments from the large mussels, when those of the smaller specimens do not occasion it any discomfort? There is. however, yet another alternative, which occurred to me one day when watching the animal life on the bottom of Nyborg Fjord through an opening sawed out from the bottom planks of the station well. A number of large *Mytilus* were visible attached to plants etc. on the bottom; here and there a large starfish *(Asterias rubens)* might be seen sucking out the contents of a mussel, and crabs *(Carcinus mænas)* moved freely about among the rest. Suddenly I saw a large crab make a dash at a starfish even larger than itself, force it away with its claws from the *Mytilus* which the starfish was in process of extracting, whereupon the crab quietly fell to devouring the remainder of the mussel itself.

I had previously observed the manner in which large crabs were able to force open the shells of mussels some 5—6 cm long by means of their claws, thrusting these in between the shells and giving a pull. Whether they seize the moment when a mussel happens to be »yawning« with its shells half open, to insert a claw between, or whether they are able by muscular force to wedge the claws in, I do not know. I have tried, by way of experiment, to open a large *Mytilus* with the fingers and a couple of wooden wedges, and came to the conclusion that a crab would not be able in this manner to overcome the resistance of the closing muscle in a large Mytilus; it is more likely that the claws are used passively as wedges to hold the shells apart, until the mussel, after continual endeavour to close them, becomes fatigued; the claws are then gradually pressed farther and farther in, until they can get a grip on the closing muscle and intestine, when the victim's last remains of strength become exhausted, and the shell can be opened wide. The contents would then be picked to pieces by the claws and lifted gradually to the mouth. Now in Bramsnæsvig, the mussels lie in great clusters spread out all over the soft bottom — valuation experiments in 1911 showed 1960 gr. or 78 *Mytilus* pr. sq. m. of bottom--large numbers of *Asterias* live among the clusters, devouring great quantities of mussels daily (in many of the clusters brought up, the adductor muscles of the individuals attacked by starfish were not yet consumed) and crabs were so numerous that fishermen could not keep the bait on their eel hooks. It occurred to me then, that the eels would here have excellent opportunity of obtaining mussels which had just been opened by *Asterias* or by crabs; they need only drive the first-comer away and could then devour the spoil themselves. In my opinion, there is much which goes to support the correctness of this view: the large, soft parts of mussels, still comparatively whole, the lack of shell fragments in the stomach contents, etc.; all seems to suggest that the mussels have been eaten »from the shell« after the shells had been opened. A similar explanation might be applicable to the previously mentioned finds of soft parts of large *Mytilus* in the stomachs of *Gobius niger* from Bramsnæsvig. The siphons of *Mya*, however, above referred to, had evidently been nipped off by a sudden and forcible bite, before the bivalve had time to draw in the part exposed above the bottom. Individuals thus maimed must necessarily die shortly after loss of the member, and the eels are therefore probably to blame for the fact that we may in summer find large, apparently undamaged *Mya arenaria* lying dead above the sand in quite shallow water; on closer examination, many of them are found to have had the end of the siphon bitten off, and we may then safely suppose that the eels have been at them.

The small eels and elvers live on young *Gammaridæ*, *Iæra marina*, *Cladocera* and other small crustaceans, insect larvæ and small worms (*Spionidæ*, *Naidæ* and the like). In order to ascertain whether the eels feed at night or by day, I have made numerous investigations and weighings of the stomach contents in specimens taken at about the same locality, but — at short, regular intervals — at different times during the 24 hours. Thus on the 13. August 1911 in Nyborg Fjord, between 11 a. m. and 2 p. m. out of sixteen eels examined, three were quite empty, 5 had empty stomachs and only a little in the rectum, only 8 having some small quantity of matter in stomach and intestine. The ratio between con-

tents of digestive tract and weight of body was as 1:169. At 3—4 next morning, before sunrise, of 14 eels now only 1 was quite empty, 6 had matter in the stomach but not in the intestine, 7 had both; the proportion had risen to 1:152. Another investigation, on the 15. August 1911, showed a more rapid rise in the figures: from 1:280 at 9—11 p. m. (8 specimens examined) to 1:120 between 12 and 1 at night (12 spec.); after this, it sank again a little, to 1:133 at 3—4 a. m. (8 spec.). At a third investigation on the $^{21}/_{7}$ 1914 — still in Nyborg Fjord — the figures varied from 1:70 at 10 p. m. to 1:50 at midnight, then down again to 1:67 at 1 a. m. rising once more to 1:59 and 1:55 at 2 and 3 a. m. respectively. A similar zigzag curve was produced by a series of investigations in Svendborg Sound on the $^{29}/_{7}$ 1914.

From this it will be seen that the eels may be found with full stomachs at night as well as by day, the results of the investigations made, however, differing to such a degree that no general rule can be formulated from these as to what time of the 24 hours eels principally feed. On the other hand, there is no doubt that eels generally are fond of feeding at night; this is shown by the frequent finds of recently devoured matter in the stomachs of eels captured quite early in the morning. It is also a well-known fact that eels are best taken on a hook at night, and it would agree well enough with the shady character of eels on the whole that they should choose the hours of darkness for their depredations. During the cold winter months, eels are known to lie buried in the soft mud of the bottom between the plants, where they remain perfectly motionless, even though the ground all about them be hacked through and through with an eel-spear. In this trance-like condition they doubtless feed very little or not at all. On the 26th Februar 1912, the stomachs of 97 eels from Kerteminde Fjord were examined; all were perfectly empty.

A glance at the lists (see list 4) of stomach and intestine contents in the Plaice (*Pleuronectes platessa*) will show that in the *d*-community, *Hydrobia* and *Mytilus* are the species which take up most space. This does not, however, agree with what has been found in Nyborg Fjord and other Danish fjords, where *Hydrobia* and *Rissoa* may, it is true, often be found in the contents of stomach, especially during the cold season, but only rarely young *Mytilus*; the high figures for these are derived from the extensive *d*-communities of the Baltic. In the fjords, the sand worms, *Arenicola marina,* doubtless form the staple food of the plaice; mollusc larvæ take only second place: *Macoma baltica, Cardium fasciatum* and the young of *Mytilus edulis, Cardium edule* and *Mya arenaria.* Besides the sand worms, others such as *Nephthys* and *Pectinaria* are also of some importance; crustaceans on the other hand, are not found at all in the stomachs of plaice from here. The *Zostera* belts of our fjords, however, do not constitute the true haunt of the plaice, though at times, especially in autumn and spring, they may be found there in great shoals consisting for the most part of younger fish.

The Dab (*Pleuronectes limanda,* see List 5) is likewise no true denizen of the plant zone, which may be most distinctly seen from the fact that the species occupying the principal place in the stomach contents lists for dab in the *d*-communities is *Abra alba,* which is not found at all in this community. Evidently, the fish in question had in their wandering moved over from the adjacent *Abra*

community to the *Macoma* area, where they were taken without having touched the true inhabitants of the spot. Among other animals not belonging to the plant region, but eaten by dabs caught here, we may mention *Ophioglypha albida* and *Terebellidæ*. The chief food here, as in the case of the plaice, is *Arenicola marina;* other Polychæta such as *Pectinaria Koreni* also play a certain part, whereas *Hydrobia* and *Rissoa* are of but slight importance. Of small bivalves, the dab takes the same as does the plaice; here likewise the small *Mytilus* are principally from the Baltic. In one respect, however, the dab differs typically from the plaice; in addition to the species mentioned, it also consumes a quantity of crustaceans: *Gammaridæ, Idothea, Mysidæ* and *Crangon,* and even small fish, such as sticklebacks and gobies.

In contrast to the two previous fish, the Flounder (*Pleuronectes flesus,* see List 6) has its true home in the *Macoma* communities, though for the most part outside the plant zone. Within this, however, it devours quantities of *Rissoa* ($^1/_4$ of total weighed content) and other small molluscs such as *Hydrobia,* or even *Lacuna divaricata;* for the rest, almost the same diet as the dab; the large number of *Corbula gibba* (see List 6) are all from the Inder-Bredning of Isefjord; the small *Mytilus* from the waters south of Sealand and the Baltic.

The flat fish live to a far greater extent on the bottom than do the species previously mentioned, which coincides with their marked preference for bottom fauna as against the epifauna of the *Zostera* and swimming creatures. It is thus very seldom that one sees a flatfish in its free natural state; they bury themselves by means of the unpaired fins so deep in the bottom that only the eyes, if anything, are visible, and it is extremely difficult to distinguish them when so concealed. Only when disturbed are they more easily discernible; a narrow strip of the bottom is seen to be scraped up for a short distance; at the point where the commotion ceases, the fish has buried itself in the sand once more. Many will doubtless have noticed this fact for themselves when wading in shallow water with clean sandy bottom, where small plaice and flounders love to roam, and I have with a diving dress observed the same thing with adult plaice and dabs on the soft bottom of the Limfjord. In the cement aquaria of the Biological Station at Nyborg, we had some plaice, the size of a man's hand, with sand in the bottom of the tanks. During the daytime it was impossible to find them, save by raking up the bottom with a stick; they had buried themselves several cm. deep, not even the eyes being visible at the surface. At night, however, or when a close cover was placed over the aquarium, so as to darken it, most of the plaice might be seen lying wholly or partly above the sand; when the cover was removed, they at once buried themselves again. In Report XX from the Biological Station, Dr. Petersen mentions, p. 63, some investigations which we made in 1910 as to the contents of stomach and intestine in plaice at different times of the day and night, and at different places in the Limfjord; as a rule, the fish were quite or almost entirely empty early in the morning, full the whole day from 8—11 a. m. to 10 p. m. In the Limfjord, then, the plaice would seem to feed only during the day, like the gobies; I do not know, however, whether this also applies to other waters, having had no opportunity of making like investigations elsewhere. Franz (Wiss. Meeres-unters. Bd. IX. N. F. Abt. Helgoland, 1910) is of opinion that the plaice

in the North Sea is a »Tagfresserin«, but that it feeds during the night on the phosphorescent *Amphiura filiformis;* he has, however, only examined a very small amount of material.

During the cold season, the flatfish in shallow water, like the eels, doubtless eat extremely little. On the 26th September 1913, 125 young plaice were taken in Nyborg Fjord, all about 24 cm. length, and all were quite empty. The haul was made at 8.30 a. m. but their emptiness was not due to the early hour, as on the next day, 450 plaice about the same size, taken in a single haul at the same spot, but at 3 p. m., were likewise almost entirely empty; of 40 specimens, only 5 had a little in the stomach, (abt. 3 gr. in all) consisting of small bivalves, *Rissoa* and polychæta.

On the 21st February 1910, 630 plaice abt. 15 cm. were taken in Nissum Bredning, Limfjord; all had a very slight stomach content, consisting of *Abra* and polychæta, on an average only 1—2 polychæta and 4—5 small *Abra* in each fish. And on the 1st March 1912, 10 flounder and 22 plaice from the Great Belt E. of Romsø, were examined; here 8 of the flounders and half the plaice were empty. It would thus seem that flatfish in deeper water eat less in winter than during the remainder of the year.

This concludes the list of fish living in the plant zone of our fjords; as will be seen from the foregoing, by far the greater part of these fish here live on crustaceans: *Gammaridæ, Idothea,* crabs, *Crangon, Mysidæ,* copepods etc., all forms particularly attached to the plants, and more especially to the *Zostera.* Pelagic copepods are, however, of importance also as food for the gobies. Only Zoarces, *Gobius niger,* wrass, and flatfish eat small gastropods, and these take only second place on their menu. The bottom fauna, worms and bivalves, are only eaten by eels, Zoarces, *Gobius niger* and the flatfish. That the crustaceans should be the most important food constituent is highly remarkable, in view of the previously mentioned proportion between the animals in the epifauna of the plant zone, see for instance Table p. 23 where the enormous quantities of *Rissoa* as compared with all others, especially crustaceans, will at once be apparent. *Rissoa membranacea* and *R. inconspicua* being annuals, the yearly production of meat is even greater than the stock at the moment, which is shown in the table as 126 gr. pr. sq. m. of bottom. The contributions levied by the fish can thus hardly be supposed to have any perceptible effect upon the size of the stock. That the quantity of the *Rissoa* nevertheless decreases considerably per 1 sq. m. from autumn to spring is rather due to the depredations of crabs and starfish, which, as indicated above, p. 23 annually consume enormous quantities of these animals. It seems then, as if the fish here, as elsewhere, prefer the rarer sorts of food, and pass by that which is most common.

The enormous quantities of crustaceans annually devoured by the fish will be seen from the following figures. According to various experimental hauls made with the »Not« (a ringshaped net which can be used for quantitative fishery) the average amount of *Gobius Ruthensparri* per 1 sq. m. at Slipshavn, Nyborg Fjord, in August 1915 was 7 gr. weight. As we have seen, these fish empty their digestive tract entirely during six hours of the night, while it is more or less constantly full during the remainder of the 24; we may therefore reckon, that

they digest every 24 hours a quantity equal to three times what they contain when full. The average weight of stomach and intestine contents for *Gobius Ruthensparri* from Slipshavn at this time was $^1/_{44}$ the weight of body; this means, that they devour $\frac{3 \times 7}{44}$ gr. pr. day, and in the course of a single summer (180 days) ca. $\frac{180 \times 3 \times 7}{44} = 86$ gr. of crustaceans per sq. m. of bottom. Even reckoning half this amount as pelagic *Calanoida*, we have still a remainder of 43 gr. consisting exclusively of crustaceans from the weed, and it is hard to realise how such a quantity can annually be obtained from a spot where the actual stock of crustaceans at a given moment only amounts to a couple of grammes per sq. m. (cf. Table p. 23). The only possible explanation is doubtless this: that several of the small crustacean species from the weed about our coasts produce several successive generations annually. I am, however, as yet unable to prove the correctness of this theory with certainty.

C. The Mud Bottom.

Leaving the plant zone of Nyborg Fjord and passing out to slightly greater depths, we encounter a soft bottom, as a rule covered with rotting vegetable remains, often so soft and full of decomposing matter that it may be termed quivering ooze. The fauna here is generally very poor, but is still composed of the typical forms of the *Macoma* community: *Macoma baltica, Mya arenaria, Arenicola marina, Hydrobia ulvæ,* also not a few red gnat larvæ *(Chironomidæ), Pectinaria Koreni* and some few other worms, large *Asterias rubens,* large crabs and predatory gastropods, *(Nassa reticulata)* and, where foothold is obtainable, as on stones, piles, remains of plants, also Ascidians or clusters of mussels *(Mytilus edulis)* with starfish *(Asterias rubens),* Polychæta such as *Nereis pelagica* and *Polynoidæ* among the masses of bivalves. The only small fish from the plant regions properly found here is *Gobius niger,* which by raking up the bottom manages to get at some gnat larvæ or *Macoma baltica.* Zoarces, like the flounder, is quite at home here, feeding on insect larvæ, bivalves and Polychæta; in the Isefjord, on similar bottom, I have also found an Ascidian *(Ciona canina)* in the stomach of Zoarces. Eels too are frequent here, numbers of them spending the winter buried in the bottom. On this ground, they feed mainly upon Polychæte worms, especially *Arenicola* and *Terebellidæ,* bivalves and young Zoarces. The sea scorpions here lie in wait for crabs, Zoarces and *Gobius niger,* but when pinched by hunger eat up anything they can get hold of, *Mytilus edulis* or *Nassa reticulata,* which with shells entire, and doubtless without furnishing any real nourishment, merely fills up the stomach (see List p. 39). The cod, on the other hand, only occasionally visit this area, possibly to pick up a delicate little crab or young Zoarces. The same may be said of plaice and dab, which find but a few of their favourite morsels here; when the former, as already mentioned, come in large shoals to the fjords during the cold season, the victims are certain bivalves and Polychæta, especially *Arenicola* and *Pectinaria Koreni.*

II. The db community.

In some of our fjords, the muddy belt of the *Macoma* community is of no inconsiderable extent, as for instance in the Isefjord, but in Nyborg Fjord it soon gives place to a transition zone between the *Macoma* and *Abra* communities, a *db* community, where *Macoma baltica* and the remaining fauna of the *Macoma* community are found together with *Abra alba* and the typical forms of the *Abra* community: *Macoma calcarea, Nephthys*, and other polychæta, *Ophioglypha albida, Diastylis*, etc. (see for instance St. No. 17 in Nyborg Fjord, Report XXI from the Biological Station. 1913. (Appendix p. 33)).

Here, where the bottom is often soft and muddy, we find flatfish, cod, and Zoarces. On consulting the lists at end of book, for the food of these fish in the *db* community, it will be found that the plaice here feed chiefly on *Macoma baltica* and *Abra alba* in about equal proportion, *Hydrobia* and *Nephthys, Arenicola* and *Pectinaria Koreni*. In addition, 84,8 gr. *Gammaridæ* is also noted; all these are from the great Bredning of the Isefjord near its mouth opening out into the Kattegat, where they are found in spots on the sandy bottom in enormous quantities, literally almost covering the ground. It is a tube-inhabiting form, *Ampelisca macrocephala,* the same which is also found in comparatively large quantities in the stomach contents of plaice in the *Venus* communities; otherwise, as the lists show, plaice very rarely eat crustaceans. The dabs likewise here feed on both *Abra alba* and *Macoma baltica, Nephthys, Arenicola, Pectinaria Koreni* and, like the plaice, some other rarer worms; in Vejle Fjord, for instance, *Priapulus caudatus,* but also *Ophioglypha albida,* various bottom forms of *Gammaridæ* and small young Zoarces.

The flounder prefers *Abra alba* to *Macoma baltica,* half the entire contents of stomach however, in this community, consisted of *Pectinaria Koreni;* of other animals only very little was found.

The stomach content of the cod is here found to consist principally of fish, e.g. Zoarces, *Gobius niger,* sticklebacks, and also the fifteen-spined stickleback; the three last, however, evidently come from the adjacent *d* community; of the remaining animals we need only mention the ophiuroids *(Ophioglypha)* and shrimps *(Crangon);* the others amount to but an infinitesimal fraction of the total content.

Zoarces here devour both *Abra alba* (over $^1/_2$ the entire content) and in a lesser degree *Macoma baltica;* in addition, the small *Montacuta,* gastropods such as *Acera bullata,* worms as *Pectinaria* and crustaceans such as *Diastylis* and finally — according to investigations from Nyborg Fjord, which are not included in the lists, as the fish and stomach contents were not weighed — insect larvæ, small *Mytilus*, and detritus from the bottom, containing small *Gammaridæ* and bottom copepods *(Harpacticoida).*

III. The Abra Community.

A. Passing now from the *db* community in Nyborg Fjord out into deeper water, (see the chart p. 20), nearer the mouth, we reach the true *Abra* or *b* com-

munity, with the small white bivalve *Abra alba (b)* as dominant character form. In Nyborg Fjord, we find together with this another character species, *Macoma calcarea (c)*, and thus obtain a *bc* community; attendant species are various other bivalves, e. g. *Cyprina islandica, Cardium fasciatum, Mya truncata, Nucula tenuis, Modiolaria nigra*, 2 *Leda* species, *Corbula gibba* and *Montacuta ferruginosa;* predatory gastropods such as *Buccinum undatum* and *Neptunea antiqua*, Polychæte worms such as *Nephthys, Pectinaria Koreni*, various *Maldanidæ* and *Terebellidæ*, also *Echinoderms* such as the ophiuroid *Ophioglypha albida*. Among the crustaceans, the small *Diastylis* are of frequent occurence; of larger forms may be mentioned *Hyas, Crangon Allmani* and *Paguridæ;* also an occasional *Carcinus mænas* may be found here, and large shoals of *Mysis mixta* move about close to the bottom; this community makes up, as mentioned, abt. 800 ha. of the total 1800 ha. in Nyborg Fjord. The *Abra* community extends, however, far out beyond the mouth of our fjords, to the belt waters and part of the western Baltic (the red dots on the chart in Biol. Station's Report XXI). The bottom is as a rule soft, mixed with detritus; where it is harder, with an admixture of gravel, we often find great quantities of the small thick-shelled bivalves *Astarte (a)*, of which *Astarte Banksii* is particularly common; otherwise, the fauna remains unchanged, and the community is therefore at such places designated as an *abc* community. North of Sprogø, we encounter *Echinocardium cordatum* in enormous numbers (the light blue tint on the chart in Report XXI) forming the *Eabc* community.

In these communities, the plaice, dab, flounder and cod are the most common bottom fish. They live, whether in *b-, bc-, abc-* or *Eabc*-communities, on the following forms; Plaice first and foremost on *Abra alba*, from list 4 at end of book it will be seen that in the *bc*-communities, e. g. just at the mouth of Nyborg Fjord, this animal makes up half, and in the *Ebc* communities over a third of the stomach content found. Even in the *ac(b)* communities, where *Abra alba*, as indicated by the parenthesis, occurs in very small quantities compared with the other forms — see for instance List of Bottom Fauna in Biol. Station Report XXI, (Appendix p. 30) the plaice seek out the few *Abra* which are to be found. That *Macoma calcarea* is less prized as food by the plaice than *Abra alba*, despite the great resemblance in outward appearance, will easily be seen from the list at end of book for the *bc-* and *Ebc*-communities; in a natural state, the two species are generally found in about equal numbers in these communities. On the other hand, it is only reasonable that *Macoma calcarea* should be devoured in greatest quantities in the *ac(b)*-communities, *Abra* being there more rare in proportion. Among the remaining bivalves of the *Abra* comunities, *Nucula tenuis* should be particularly noted, often occurring in quantities, especially in the Samsø Belt, and being devoured in great numbers. Likewise the young of *Cyprina islandica;* the adult individuals, on the other hand, are not eaten by any fish. The other small bivalves, *Leda* and *Modiolaria*, are found and eaten only to a slight extent. Polychæta are the next main constituent in the food of the plaice here, chiefly *Nephthys*, then *Terebellidæ;* the places where *Arenicola* was also found in the stomach content all lie near the *Macoma* community of the coast, whence they may possibly have been brought.

The comparatively few, as a rule large, flounders found in these communities, live, like the plaice, on *Abra, Macoma calcarea* and polychæta.

The dabs are not content with these, but add great quantities of the ophiuroid *Ophioglypha albida* (over $^1/_3$ of total content) which is found in great numbers everywhere throughout the *Macoma* communities, also the young of *Echinocardium cordatum;* and further, various crustaceans, of which, however, some few, as *Idothea,* must be presumed to come from an adjacent *Macoma* or *db* community; the same applies to the small remains of Zoarces and *Gobius* here found in the stomach of dabs.

The food of the cod here consists mainly of small fish and crustaceans, of the former especially small dabs, herring and sprat; the Zoarces and gobies found must have been taken from an adjacent *d* or *db* community. Among crustaceans, *Carcinus mænas* is still predominant, but also *Hyas, Paguridæ* and *Crangon Allmani* are frequently devoured. Further, various worms, such as *Nephthys, Nemerteans* and *Priapulus,* and of predatory gastropods *Buccinum undatum,* which the cod — as occasionally also the dab, eel and Zoarces — contrives to extract from its shell; the manner in which they may be supposed to effect this (by shaking the creature out) I have already described in Biol. Station Report XXII, p. 67.

There are, however, in the *Abra* communities, a number of animals which, though found in innumerable quantities, are never eaten by any fish; this applies, for instance, to the three *Astarte* species: *A. Banksii, A. borealis* and *A. elliptica,* of which I have only once found a single small specimen of *A. Banksii* in the stomach of a plaice, doubtless swallowed »by mistake«. These little bivalves, which may often be found in hundreds on every square metre of the bottom in the Belt waters, are thus carefully avoided, even by the flatfish, which otherwise eat most species of small bivalves; the reason is doubtless that the fish are unable to bite through the heavy shell, and cannot thus derive any benefit from the contents. The same circumstance, together with size, also protects the grown *Cyprina islandica* from the attacks of fish: *Mya truncata,* on the other hand, big as it is, may nevertheless at times have its long siphon bitten off by a cod. Over half, abt. 100 gr., of the stomach contents in six cod from an *Eabc* station NE. of Refsnæs Light, consisted of siphons of large *Mya truncata* (not weighed, and therefore not included in the list). The adult *Echinocardium cordatum,* which is found in enormous quantities in the *Eabc* communities, is, like the large sea urchins *Echinus miliaris, E. esculentus,* and *Strongylocentrotus drøbakiensis,* never eaten by any fish, though young specimens of the last-named species may at times be taken by cod.[1])

[1]) It would be natural to suppose that the same should also apply to the lobster *(Homarus vulgaris).* According to the statements of several fishermen, however, it is not uncommon to find even fairly large lobsters in the stomachs of large cod from the Kattegat, and I am assured from the same quarter that the lobsters are not always soft in the shell, i. e. not in process of changing. How the cod manage to avoid the terrible claws of the lobster it is difficult to understand.

B. The Limfjord.

The conditions noted for Nyborg Fjord are roughly also applicable in the main to all other Danish Fjords; special mention should, however, be made of the Limfjord, which, as a matter of fact, should hardly be called a fjord at all. Save for the plant zone along its shores, which in all essentials corresponds entirely to similar parts of the waters inside the Skaw, the Limfjord is a shallow water, with considerable current, the bottom for the most part soft, and with a great admixture of detritus, affording especially favourable conditions for the small bivalves, of which *Abra alba, A. nitida, Solen pellucidus* and *Corbula gibba* are particularly numerous. It is thus mostly an *Abra* community, but without *Macoma calcarea* and *Astarte,* while instead of *Ophioglypha albida,* we here as a rule find *O. texturata.* The most common bottom fish here are flatfish, eels, Zoarces, sea-scorpions, *Gobius niger* and cod.

The few quantitative investigations as to the food of the cod in the Limfjord, recorded at end of book, do not show very much, but from previous investigations, not carried out on a quantitative principle, it has been found that bivalves such as *Solen, Mya, Abra* and *Corbula* are of frequent occurrence in the stomach content, a thing which is very rarely noted in other waters under natural conditions; I have, however, in cod taken in traps from Nyborg Fjord, found a not inconsiderable stomach content, made up for the most part of bivalves, viz: *Abra alba, Cardium fasciatum* and *Mytilus edulis*, the remainder consisting of *Rissoa,* thus altogether a quite unusual diet for cod. It must be supposed, that the cod, after having been a couple of days in the trap, where they would be unable to obtain their normal food, must from sheer hunger have been driven to eat small molluscs.

Plaice in the Limfjord live mainly upon the small bivalves above mentioned, which make up nearly $^2/_3$ of the total stomach content (see list 4); the gastropods *Philine aperta* and *Acera bullata* are also of importance, often occurring in great numbers in the Limfjord; third in order come the Polychæta, especially *Nephthys, Pectinaria Koreni* and *Nereis virens,* which have already (in the section on sea-scorpions) been mentioned as an important source of nourishment for nearly all fish in the Limfjord at certain seasons of the year. For the dab and flounder also, the mentioned molluscs are of far greater importance in the Limfjord than in the waters previously referred to, as will immediately be seen from Lists 5 and 6 at end of book, showing the food of these species; the same further applies, it will be noticed, to the eel and Zoarces, while with regard to the sea-scorpions, these have been dealt with in the foregoing. The *Abra* noted in the list of food forms for *Gobius niger* are likewise all from the Limfjord. Small bivalves thus play a far greater part for the fish in the Limfjord than in corresponding waters farther south, but it would seem that the species predominating in this respect are not every year the same. Thus the young of *Mya truncata* were in previous years (e. g. before 1908—09) the chief food of the plaice of Thisted Bredning and many parts of the adjacent waters, as for instance in Hvalpsund and Sallingsund; during later years, *Abra, Solen* or *Pectinaria* have taken the principal place.

IV. The Baltic.

In the Baltic, both the western part and the true Baltic waters, there is an extensive *da* community; i. e. one where the animals of the *Macoma* community are found together with *Astarte,* mostly *A. Banksii,* and frequently in great numbers. As will be seen from the lists at end of book, these thick-shelled bivalves are likewise left untouched. The plaice feed here, however, as in the rest of the Baltic waters where pure *Macoma* communities are found, on *Hydrobia, Macoma baltica, Mytilus* and worms; the dabs eat *Mytilus, Macoma baltica,* small *Mya arenaria,* worms and crustaceans; the flounders *Macoma baltica* and worms.

V. The Tellina tenuis Community.

In contrast to the rich fauna of the sheltered fjords, we find in the Kattegat and in the northern parts of the Belts, on the low and open, sandy coasts, which are exposed to strong wave action, a peculiar modification of the *Macoma* community fauna, which has been named after the species there most common: *Tellina tenuis.* This is noted in the lists as the *d. ten.* community. The plant growth in this region is extremely scanty or altogether lacking, the bottom is clean white sand, containing but the very poorest representation of the *Macoma* community's fauna, the epifauna in particular is very sparsely found, if at all (see for instance St. 37—39 in the Kattegat and St. 28—29 in the Samsø Belt, Biol. Stat. Report XXI, Appendix p. 14 and 24—25). Besides the *Macoma* fauna and *Tellina tenuis* there may often, especially in autumn, be numbers of small young *Mactra subtruncata* in this community, while the Polychæta *Travisia Forbesi, Aricia armiger* and *Ophelia limacina* are typical for the hard bottom there found. The most important fish are plaice, flounder, dab, cod, and *Gobius minutus.* For the two species first mentioned, the *T. tenuis* community is of especial importance, as being the haunt of the young fish, which, as soon as they attain the bottom stage after their pelagic period of life, move in to the coast, and feed there on copepods, ostracods, young Polychæta and *Gammaridæ.* As they grow up, however, and are better able to stand a harsher diet, they begin — as do the dabs, which spend their first youth in deeper water, and only later come right in to the coast — to take the available bivalves (see Lists 4—6): *Tellina tenuis, Mactra, Thracia, Mya, Cardium* and *Mytilus.* Small gastropods are, with good reason, but rarely found in their stomachs, but Polychæta such as *Arenicola, Pectinaria, Nephthys* and *Ophelia* are taken in abundance; also a quantity of *Gammaridæ* and *Idothea,* especially by the flounders. The dabs also eat *Ophioglypha albida,* which by the way, is here of somewhat rare occurrence, *Hydroidæ,* otherwise generally avoided by fish, and *Gobius.* The food of the cod in this community (see List 1) is mainly crustaceans, such as crabs, *Crangon* and *Gammaridæ;* some few Polychæta, and a few small fish, as for instance *Spinachia* and *Syngnathus typhle.* Besides *Gobius minutus,* which, as mentioned, is common, the remaining small fish are also found here,

though far less abundant than in the fjords, and their food is for the most part the same as there; this applies also to *Gobius minutus,* which also in the *T. tenuis* community feeds chiefly on copepods and *Mysidæ.*

VI. The Venus Community.

There are in the Kattegat large tracts of bottom often more or less mixed with sand, where the »*Venus*« bivalves *Venus gallina, Tellina fabula, Mactra subtruncata* and *Thracia papyracea,* denoted by a *v,* are predominant. There are very few gastropods here, but many species of Polychæte worms, including *Nephthys, Pectinaria* and the sandworms above mentioned, *Travisia Forbesi, Aricia armiger* and *Ophelia limacina.* This community has its outer boundary indicated by a red line on the chart in Biol. Station Report XXI. The pale blue area immediately inside this line is also inhabited by *Echinocardium cordatum,* and therefore designated *Ev;* for samples of the fauna in the *Ev* and *v* communities, see Biol. Station Report XXI, Appendix, p. 11—12 and p. 13 respectively. As a transition between the *Macoma* and the *Venus* communities we have the *dv* community, with a mixed fauna. These communities have for the sake of convenience been taken together in the lists at end of book, as the fish in the main feed on the same diet in all three.

It will be noticed that for the flatfish, *Mactra subtruncata* is beyond comparison the most important of the bivalves; the young of this species appear, as already mentioned, in great quantities on the Danish shores of the Kattegat during autumn, probably coming from the North Sea, for in the course of the winter, they again disappear — having perhaps been eaten up — and none, or very few at any rate, of the adults remain behind to continue the species. The remaining bivalves of the *Venus* group are, in comparison, very unimportant, they are hardly ever eaten, despite their high numerical value throughout all the *Venus* communities. The Polychæta on the other hand, are an important source of nourishment for the flatfish; *Arenicola* in the *dv* community, *Nephthys, Pectinaria* and the sand-dwelling Polychæta of the above-mentioned species, with the Terebellide *Lanice conchylega,* which lives in tubes of sand, but which the fish must somehow contrive to extract therefrom, since the tubes were not found in the stomach. The dab, in contrast to the flounder and plaice, eats the ophiuroid *Ophioglypha albida,* the young of the large echinoderm *Echinocardium cordatum* and the small *Echinocyamus pusillus.* Finally, all three species of flatfish devour quantities of bottom-gammaridæ, especially of the tube-dwelling *Ampelisca macrocephala* above mentioned, which are found, divested of their flat sand tubes, in the stomach of the fish. These *Gammaridæ* are found in great numbers in certain parts of Aalborg Bay.

The food of the cod in the *Venus* communities consists of fish, e. g. dab, long rough dab, herring, and *Gobius minutus;* in addition *Amphioxus lanceolatus* and fish roe, as also crustaceans; hermit crabs, removed from their shells, crabs, shrimps, and *Gammaridæ.* In a lesser degree also, certain worms, such as *Echiurus* and *Nemerteans,*

VII. The E.B.Fil.Ch.-Community.

On the soft bottom in the deeper parts of the Kattegat (outside the red line on the chart in Biol. Stat. Report XXI) we find various communities with the two echinoids *Echinocardium cordatum (E.)* and *Brissopsis lyrifera (B.)* and the two ophiuroid species *Amphiura filiformis (Fil.)* and *Amphiura Chiajei (Ch.)* as character forms. The manner of distribution is as follows: *E. Fil.* is found nearest the coast on the mixed bottom, and *B. Ch.* solely dominant in the deeper parts of the Kattegat on the softest clay bottom. Attendant species are the gastropods *Aporrhais pes pelecani* and *Turitella terebra* (noted as *T* on the chart) in the *E. Fil.* Community; the small bivalve *Nucula sulcata* (noted as *n* on the chart) in the *B. Ch.* community, with various species of bivalves *(Cyprina islandica, Macoma calcarea* etc), gastropods *(Buccinum undatum, Neptunea antiqua, Philine aperta),* Polychæte worms (including *Nephthys, Pectinaria belgica, P. auricoma, Ammotrypane aulogaster,* various *Phyllodocidæ, Maldanidæ, Sabellidæ* and *Terebellidæ),* as also crustaceans; hermit crabs *(Paguridæ),* swimming crabs *(Portunus), Diastylis* and *Gammaridæ.* (See Report XXI, Appendix p. 1—8).

The most important food fish in these communities are the plaice, dab, cod and haddock. The principal food of the plaice (see list 4) is Polychæta, e. g. *Nephthys, Ammotrypane aulogaster, Pectinaria belgica, Phyllodoce maculata* and *Terebellidæ;* also some few bivalves, such as *Macoma calcarea, Solen pellucidus* and *Nucula tenuis* and a very few gastropods; *Chiton, Cylichna* and *Philine aperta.* The dab (List 5) on the other hand, prefers crustaceans, such as *Paguridæ* (without shell) and ophiuroids, such as *Amphiura* and *Ophioglypha affinis,* feeding only to a lesser degree on worms, such as *Nephthys, Pectinaria, Terebellidæ, Sabellidæ* and nemerteans, Gastropods, as *Philine,* and bivalves as *Solen.* The chief food of the cod is here crustaceans — the many *Nephthys* in List 1 are mostly from a single investigation — *Paguridæ,* swimming crabs, *Diastylis* and *Gammaridæ;* also worms such as *Nephthys, Terebellidæ, Echiurus, Phyllodoce maculata* and *Aphrodite aculeata,* and fish; dabs, whiting *(Gadus merlangus)* the dragonet *(Callionymus maculatus);* also *Amphioxus* is taken here. The food of the fish in these deeper communities is, however, comparatively little investigated, especially as regards the haddock; for the food of this fish see p. 63.

VIII. Rich Modiola Community.

The *E. Fil.* community in the southern Kattegat and the *abc* and *Eabc* communities of the Belts contain, in places where there is much current, a peculiar epifauna, distinguished in particular by a wealth of echinoderms, first and foremost the ophiuroids *Ophiopholis aculeata* and *Ophioglypha robusta, O. affinis* and *O. albida;* then holothurians, such as *Psolus phantapus* and *Phyllophorus pellucidus,* also sea-urchins as *Strongylocentrotus drøbakiensis* and further, by enormous clusters of the large bivalve *Modiola modiolus,* there often lying so close together that as to give a rough weight of several thousand grammes per sq. metre bottom (see Appendix

in Biol. Stat. Report XXI, p. 15—17 and 25—26; the stations are noted on the chart with black spots). Among the Polychæta, *Trophonia plumosa* especially is typical of this community.

The food of the plaice (see *R. M.* community in List 5 at end of book) is here the same as in the *E. Fil.* or *abc* communities, as they do not eat any of the above-mentioned character forms; this community is therefore not separated in the lists from the remainder. Dabs, on the other hand, feed in the rich *Modiola* communities largely upon *Ophioglypha robusta, affinis* and *albida,* with certain of the Polychæta, but none of the bivalves.

The food of the cod (see List 1) in this community, where they are often found in great shoals, consists preeminently of echinoderms, *Ophiopholis aculeata* alone being devoured in such quantities as to make up half the total weighed contents of stomach; they also, however, eat *Ophioglypha* and holothurians, even the spiny *Strongylocentrotus drøbakiensis* is taken in large numbers. As an item of secondary rank we have fish, especially the dab, but also whiting *(Gadus merlangus), Callionymus maculatus,* the butter fish *(Centronotus gunellus)* and Zoarces; the two last named species, by the way, are not common in this community. Further, fish roe, doubtless that of the lumpsucker *(Cyclopterus lumpus)* and a number of crustaceans, both crabs, *Paguridæ* picked out of their shells, *Crangon* and *Gammaridæ*, also Polychæta, including many *Trophonia plumosa,* and finally, a not considerable quantity of predatory gastropods, *(Buccinum* and *Neptunea)* picked out from the shell, and — strangely enough — a quantity of sea-anemones *(Actinozoa),* both the larger forms which are found adhering to stones and shells, and *Cerianthus,* which bores itself down into the bottom. The stinging cells on the arms of these creatures do not appear to trouble the cod. On a single occasion, we found the bitten off foot of a large bivalve, *Cardium echinatum.*

IX. The Haploops Community.

Finally, brief mention should be made of the *Haploops* community, an area in the Eastern Kattegat, characterised by its enormous numbers of the small tubicular Gammaride *Haploops tubicola* (noted in the chart to Biol. St. Report XXI by a black line; see also Appendix to same p. 4—5). Besides *Haploops,* the bivalves *Lima Loscombii* and *Pecten septemradiatus* and the crab *Hyas coarctatus* are characteristic of the soft clay bottom in this community, from which the flat tubes of *Haploops* project in such numbers as to give the ground a spinous appearance.

Plaice would seem to be but rarely found in this community; at any rate, none were captured there during our investigations. The few dabs brought up in the net by four successive trawlings over the *Haploops* ground in 1912, 1913 and 1914 all contained mostly *Haploops tubicola* without the tubes; in one instance also a few Polychæta, *Ophiodromus vittatus* and *Harmothoë sp.* The fish were not weighed, and are therefore not entered on the lists. The cod contained mainly *Hyas coarctatus;* in one cod of 56 cm length, 20 specimens were found, together with a piece of coal slag; thereafter *Crangon* and *Haploops,* likewise without the

tubes (see *Ha* community in List 1). How the fish manage to extract the *Gammaridæ* from their tubes I am not quite able to say, but presume that by biting at the tubes, they induce the inmate to emerge, and then snap it up in the water, as *Haploops* does not appear to leave its residence under normal conditions. This last I have been able to ascertain by taking up a clod from the bottom in this community, and placing it in a bucket of water. Not until formalin was added to the sea water, whereby the creatures gradually died, did any of them emerge from their tubes.

X. Brief Summary of the Chief Nourishment of the most common Bottom Fish already described in the natural Main Divisions of the Danish Waters.

In the foregoing, mention has been made of the stomach contents found by investigations at the Biological Station extending over a period of 25 years, in the most common of our bottom fish; cod, eel, Zoarces, sea-scorpions, and small fish from the *Zostera* along our coasts; *(Gobiidæ, Labridæ, Spinachia, Gasterosteus* and *Syngnathidæ).* The investigations were for the most part quantitative, both contents of stomach and the fish themselves being weighed, and the fractional proportion of each separate constituent to the whole ascertained.

All the above mentioned species are exclusively carnivorous; the slight quantity of plant remains found in the stomachs of various fish must be regarded as accidental. For the rest, each individual species of fish chooses, as a rule, certain particular animals or groups of such for its food, though the diet may vary very greatly according to locality. In the course of the work it has been found that Dr. Petersen's division of the Danish waters according to their bottom fauna communities (Biol. St. Report XXI, 1913) may very well be taken as the basis for a description of the food of our bottom fish. A detailed division on these lines has therefore been made in the foregoing; we have here merely to recapitulate the essential features in the principal food of the mentioned species within the main sections of the Danish waters.

The cod *(Gadus callarias)* feeds principally on fish, crustaceans and echinoderms; in the plant zone and along the coasts, where it spends its first years of life, it subsists mainly on crabs and smaller crustaceans; also, and especially in the adult, migratory stage, on the small fish of the plant region. In the deep channels running from the Kattegat down into the Sound, or extending through the Samsø Belt into the Great Belt, and where we find a rich echinoderm fauna, accompanied by large *Modiola modiolus*, the staple food of the cod is *Ophiopholis aculeata,* which makes up almost half the total weight of all examined stomach contents from these localities (see List 1 at end of book under the heading *R. M.*). Also Ophiuroids, such as the *Ophioglypha* species, and the holothurians *Phyllophorus pellucidus* and *Psolus phantapus;* in addition, the cod here also devour a quantity of crustaceans, some worms, especially *Trophonia plumosa,* a number

of flatfish and the large gastropods *Neptunea antiqua* and *Buccinum undatum*, which are always found without shell in the stomach contents. Outside these channels, the cod feed mainly on fish, especially dabs and crustaceans, (crabs, *Paguridæ*, and shrimp forms), also a quantity of Polychæta, especially *Nephthys* and *Aphrodite aculeata;* even actinians, which are otherwise rarely eaten by fish, are liable to be taken by the cod. The cod is thus by no means a dainty feeder; even cockchafers have been found in the stomach of cod from the Great Belt. Only one class of animals rarely tempts the cod, to wit, bivalves; remains of such (*Mya, Solen, Corbula*) have only been found in cod from the Limfjord. In the Baltic, the chief food is *Idothea* and *Mysidæ*. The cod is a migratory, social and highly voracious fish, feeding both day and night.

The Plaice (*Pleuronectes platessa*) exhibits a distinct preference for Polychæta and lamellibranchs; in the fjords and along the coasts, it feeds principally on *Arenicola marina*, then other Polychæta, such as *Pectinaria Koreni* and *Nephthys;* further, small bivalves such as *Macoma baltica*, the young of *Mytilus edulis*, *Cardium edule* and *Mya arenaria*, and finally, to a lesser degree, the innumerable small gastropods of the plant zone: *Rissoa* and *Hydrobia*. On the soft ground of the Belts, we again find Polychæta, and especially the *Nephthys* species, as its chief food, also the small bivalves, however, *Abra alba, Macoma calcarea* and *Nucula tenuis* are of great importance for the plaice in our Belt waters. On the sandy bottom of the Kattegat (see under *dv., v., Ev.* in List 4 at end of book) the young of the small white bivalve *Mactra subtruncata* take first rank as food for the plaice; every autumn the stomachs of the fish are found distended with great quantities of these small forms, which never manage to grow up in the Kattegat at all; next spring, the adults are nowhere to be found, but in the course of the summer a new swarm of young comes in, probably carried by the current from the North Sea. Many kinds of Polychæta also are eaten by the plaice in the Kattegat, especially *Arenicola* and *Nephthys*. On the soft clay-blended bottom farther out towards the deeper parts of the Kattegat, various species of Polychæta are also eaten, and of small bivalves, especially *Macoma calcarea*. In the Limfjord, the small bivalves are more important as food for plaice than the Polychæta; *Solen pellucidus, Abra alba, Corbula gibba* and the young of *Mya truncata* are found in quantities in the stomach of plaice from here; in addition, not a few Bullidæ, especially *Acera bullata*, and finally, various Polychæta, particularly *Nephthys* and *Pectinaria Koreni*. In contrast to most other fish, the plaice eat comparatively few crustaceans. In the Isefjord however, and various other localities with sandy bottom in the Kattegat we find a tubicular Gammaride, *Ampelisca macrocephala*, which is much sought after by the plaice, and in the Baltic, where there may at times be a shortage of Polychæta and bivalves (*Mytilus edulis* and *Macoma baltica* are the most common), we again find them taking at times to *Gammaridæ* or *Idothea*. Also echinoderms are but very rarely found in the stomach of plaice; in the deep parts of the Kattegat however, they sometimes eat *Amphiura filiformis*. Plaice feed, at any rate in the Limfjord, only during the day; in the cold season they take very little nourishment (p. 48).

The dab (*Pleuronectes limanda*) feeds on bivalves, Polychæta, echinoderms and crustacea. It devours about the same quantity of Polychæta as the plaice,

but also preys to a very high degree on various species of ophiuroids, especially *Ophioglypha albida,* and others of the same genus. It likewise eats young echinoids, such as *Echinocardium cordatum* and *Echinocyamus pusillus.* Finally, a quantity of smaller crustaceans: *Gammaridæ, Idothea, Mysidæ, Crangon, Palæmon,* and even small crabs (*Carcinus mænas*). In the Limfjord, the dabs account for not a few *Philine* and *Acera bullata* (see List 5 at end of book). Also Actinians, *Hydroidæ,* small fish and fish roe now and again fall a prey to these voracious fish, which may thus fairly be said to reject nothing in the way of meat diet. In contrast to plaice and flounder, the dabs swallow their food whole, without masticating it first.

The flounder (*Pleuronectes flesus*) feeds on bivalves, gastropods, Polychæta and Crustacea. In our fjords and coastal waters it devours quantities of the small gastropods inhabiting the plant growth, especially the *Zostera;* here for instance the *Rissoa* species *membranacea* and *inconspicua* (see under heading *d* in List 6 at end of book, where the *Rissoa* amount to $^1/_4$ of the total contents). Of bivalves, it prefers *Macoma baltica* and small *Mytilus edulis,* the latter especially constituting its chief food in the Baltic and the waters south of Sealand; in the Isefjord however, it devours a quantity of *Corbula gibba,* and on the soft bottom in the deeper parts of the fjords and Belts especially *Abra alba.* In the Kattegat it is, like the plaice and dabs, fond of *Mactra subtruncata;* in the Limfjord mostly *Solen pellucidus.* Of Polychæta it prefers *Pectinaria Koreni, Nephthys* and *Arenicola;* in the Limfjord it will also, in spring, consume considerable quantities of the large species *Nereis virens,* doubtless in epitochal form. The crustaceans are for the most part small forms: *Gammaridæ, Idothea* and *Crangon;* with at times a small crab. Only very rarely have I found remains of fish in the stomach of a flounder, and then mostly sticklebacks or gobies.

The eel (*Anguilla vulgaris*) may be regarded as feeding on Crustacea, Polychæta, bivalves, gastropods and fish. For the rest, we may refer to List 3 at end of book, whence it will be seen that the eel in the *d* communities; i. e. in our fjords and along the coasts, lives for the most part on smaller crustaceans, especially *Idothea, Gammaridæ,* and crabs (nearly $^1/_2$ the total content); then come small fish, Polychæta, bivalves, and finally gastropods. In the Limfjord, we find a different order of precedence: *Polychæta, bivalves* (especially *Solen pellucidus*), gastropods (*Philine* and *Acera*) crustaceans and small fish. The bivalves are as a rule small forms, but in Bramsnæsvig, Isefjord, the eels contrive to extract the soft parts of large *Mytilus edulis* from the shell. How they manage to do this it not easy to see; possibly by driving off crabs or *Asterias* from the mussels which these have just opened (vide supra p. 44—45). Eels feed both by day and night. In winter they eat very little if at all (p. 46).

The viviparous blenny (*Zoarces viviparus*) feeds on crustaceans, bivalves and gastropods (see List 2). In our fjords and coastal waters it devours especially the small *Gammaridæ* and *Idothea* (nearly half the entire stomach content) and a considerable number of small molluscs such as *Rissoa, Hydrobia,* also the large gastropod *Buccinum undatum,* which it contrives, like the cod, to extract from the shell. Of bivalves, it eats only small forms, especially *Macoma baltica* and *Abra alba;* on rare occasions also, Zoarces have been found to contain remains of small

fish, chiefly gobies and herrings; insect larvæ, on the other hand, are frequently found in the stomach, often those of the genus *Chironomus*. The Zoarces is a comparatively slow-moving fish, procuring its food by systematically searching every clump of algæ on its way; it does not appear to feed at night (p. 42).

The sea-scorpion (*Cottus scorpius*) eats fish and crustaceans. As will be seen from the List p. 39, over half the weighed contents of stomach consisted of small fish; stickebacks, gobies (both *Gobius Ruthensparri* and *G. niger*) pipefish, sand-eels, herring, and fifteen-spined sticklebacks; even small cod, eels, Zoarces and whiting. Crustaceans make up 300 gr. of the total weight of 700 gr. In the plant zone of our fjords and coasts it preys particularly upon *Idothea, Gammaridæ,* prawns (*Palæmon*) and crabs; outside this region mainly on *Crangon vulgaris*. In the Limfjord, I have found *Paguridæ*, without the shells, in the stomach of sea-scorpions, and, in the same water, the *Nereis virens* already mentioned is of some importance as food for the sea-scorpion during spring. The sea-scorpion is a voracious fish, lying in wait for its prey close on the bottom, and apparently feeding both night and day.

The young of the above fish live, whatever may be their food when fully grown, during the pelagic stages without exception upon pelagic copepods, at times also Cladocera or pelagic gastropod and lamellibranch larvæ.

The small fish of the plant zone, inhabiting our fjords and coasts; i. e. the following species: *Gobius minutus, G. Ruthensparri, G. niger, Gasterosteus aculeatus, G. pungitus, Spinachia vulgaris, Syngnathus typhle, Nerophis ophidion, N. æquoreus, Ctenolabrus rupestris* and *Crenilabrus melops,* all feed first and foremost upon crustacea. The five first-named species, with the exception of *Gobius niger,* live, like the young of all small fish, upon copepods, both pelagic (*Calanoida*) and bottom forms (*Harpacticoida*); also on small crustaceans from the vegetation, *Gammaridæ, Idothea, Mysidæ* and *Crangon,* these crustaceans making up the chief food of all the remaining small fish above mentioned. *Gobius niger, Ctenolabrus rupestris* and *Crenilabrus melops* also feed upon small molluscs (*Rissoa, Hydrobia, Lacuna, Acera, Modiolaria,* small *Mytilus*), Polychæta and insect larvæ; the pipefish (*Syngnathus typhle*) devour, besides crustaceans, numbers of small fish, especially *Gobius Ruthensparri;* see also the respective lists p. 25—33). *Gobius niger* seeks its food, like the sea-scorpions, close to the bottom; the pipefish lie in wait among the Zostera leaves, the remaining small fish, on the other hand, range about in small shoals through the Zostera; *Gobius Ruthensparri* and the three- and ten-spined sticklebacks nearest the surface, *Spinachia* lower down. Most of the small fish appear to feed only during the day time. Investigations of the contents of stomach in *G. Ruthensparri, G. minutus, Gasterosteus aculeatus, Syngnathus typhle* and *Nerophis ophidion* from Nyborg and Svendborg Fjords at different times of the day and night showed that they were as a rule empty early in the morning before sunrise (vide supra p. 35—37); this may possibly be due to the fact that they hunt by sight when feeding on the small crustaceans (especially copepods). In winter the small fish appear on the whole to eat but little (p. 38).

From what has been said in the foregoing (p. 18—58) as to the fauna of the various communities and the staple food of our most common fish there, it

will be seen that a great number of forms, particularly those of most frequent occurrence, are not eaten at all, or at any rate but rarely, by the fish. In the fjords, this applies especially the large, grown specimens of *Mytilus edulis,* which species probably amounts to the greatest weight of any per sq. m. of bottom in our fjords; *Mya* and *Cardium edule*, *Arenicola marina* in quite shallow water, *Asterias rubens* and the large *Littorina littorea;* further we may mention *Hydroida, Bryozoa* and *Actinozoa,* which are only eaten to a very slight degree; most of the *Rissoa* must be presumed to fall mainly to the share of crabs, starfish and other lower animals, as already mentioned in the foregoing (see p. 23). In the more open waters, we have of thus neglected forms *Astarte* and the grown specimens of the following species: *Cyprina islandica,* the *Pecten* species, *Mya truncata, Cardium echinatum* and *Modiola modiolus;* also *Nucula sulcata, Aporrhais pes pelecani, Turritella terebra,* the large echinoderms; *Asterias rubens, Solaster papposus* and *endeca, Cibrella sanguinolenta,* the echinoids, as for instance *Echinocardium* and *Brissopsis,* in other words, most of the character forms. Of worms on the other hand, there are very few which are not eaten by fish, and among our most common crustaceans, even the lobster, with its thick shell and heavy claws, is not exempt from their attacks (see p. 52, Note).

The animals which suffer most are evidently the Crustaceans; we have thus already mentioned (p. 48) that the chief food of the small fish consists of these, and they are likewise an important source of nourishment for the sea-scorpions, Zoarces, eels, cod and dabs, being also eaten by flounder and plaice, in other words, all the fish mentioned in the foregoing. The Polychæta are of most importance for the flatfish and eels; less for the cod and least of all for Zoarces, sea-scorpions and small fish; the echinoderms most for the cod, especially in the *R. M.*-communities, and the dabs; the gastropods for the eels, Zoarces, flatfish, cod and some few of the small fish (*Gobius niger* and the *Labridæ*) but are everywhere eaten only in comparatively small quantities. Finally, bivalves are eaten only by flatfish, eels, Zoarces and the small fish above mentioned.

XI. On the food of certain other Bottom Fish.

In addition to the species mentioned in the foregoing, I have yet to note several bottom fish in regard to which I have not sufficient investigations to determine with certainty what is their most important food; I will therefore here merely give the lists of the stomach contents as found, together with a brief survey of what may from these be supposed to be the staple nourishment of the species in question within our waters.

The whiting (*Gadus merlangus*) feeds on Crustacea and fish. The investigations of the larger specimens were made for the most part in the south-eastern Kattegat, where the whiting, in the »*Haploops*« localities, lives almost exclusively on *Haploops tubicola.* The small individuals which are occasionally taken in the Belts and fjords eat chiefly *Gammaridæ, Crangon vulgaris, Mysidæ* and *Gobius*

Ruthensparri; in Kallundborg Fjord we have also found *Nereis pelagica* in the stomach of young whiting.

The haddock *(Gadus æglefinus)* feeds in the Danish waters evidently upon

Gadus merlangus.

27 investigations, comprising in all 125 spec., length 4–32 cm, depth 8–51 m.

1625 gr. Fish.

No. of specimens.	Not weighed:																		Weighed: 39.	
	?	3.	4.	1.	12.	1.	2.	24.	1.	7.	3.	1.	3.	1.	1.	14.	1.	2.	1.	
Polychæta	..	..	..	..	..	..	..	..	..	..	1/2	..	..	..	..	..	..	..	..	
Nereis pelagica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2/5	..	..	..	
Eumenia crassa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1,60 1,60
Ophiuroids	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Amphiura Chiajei	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
» filiformis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Ophiopholis aculeata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Gammaridæ	..	..	..	..	..	..	1/5	3/4	1/2	..	..	..	1/1	1/6	..	..	..	..	..	
Caprella	..	..	..	..	..	..	4/5	..	..	..	..	..	..	..	..	..	..	..	..	
Zoëas	..	..	..	..	..	..	..	..	..	..	..	..	..	1/6	..	..	..	..	..	
Arcturus sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	1/6	..	..	..	..	..	
Moera Loveni	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1,70
Haploops tubicola	..	..	..	..	..	..	..	..	..	1/1	1/2	..	..	..	..	..	..	..	..	23,00
Idothea sp.	⅄	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Diastylis sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/10	..	..	..	31,40
Mysis mixta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2/5	..	..	..	
» sp.	+	..	..	..	1/4	..	..	..	..	..	..	..	..	..	1/1	..	..	..	..	0,50
Crangon vulgaris	..	..	..	..	..	..	..	..	..	..	..	1/1	..	..	..	..	..	..	..	
» Allmani	..	..	..	..	..	1/1	..	..	..	..	..	..	..	..	..	..	..	..	..	4,20
» sp.	..	..	..	..	1/2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Palæmon sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2,00
Calanoida	..	..	..	..	..	..	..	..	1/2	..	..	..	..	1/2	..	..	..	..	..	
Gobius Ruthensparri	..	..	..	..	..	..	..	1/4	..	..	..	..	..	..	..	..	..	..	1/1	
» sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/10	1/1	..	..	
Clupea harengus	..	1/1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1/1	..	
Remains of fish	+	..	1/1	1/1	1/4	..	..	..	+	..	..	..	..	..	..	..	..	..	..	

Total stomach content gr.... 33,00

Proportion of rough weight of stomach content to weight of body... (1/49)

The sign + = few.
— ⅄ = many.

echinoderms and Crustacea; the few investigations made are all from the Kattegat, and show, that the haddock here live chiefly upon Ophiuroids, especially *Amphiura filiformis* and *A. Chiajei,* which are very common in the deeper parts of the Kattegat. According to R. A. Todd (Mar. Biol. Ass. of the United Kingdom. International Fishery Investigations. First Report on Fishery and Hydrographical Investigations in the North Sea and adjacent waters (Southern Area) London 1902—03. Second Report etc. London 1904—05) the haddock in the North Sea

Gadus æglefinus.

5 investigations, comprising in all at least
7 spec., length 25—50 cm,
depth abt 50 m.

No. of specimens.	Not weighed:				
	?	?	?	2.	2.
Nereis pelagica	..	+	..	..	..
Ophiuroids	⅄	..	..	..	..
Amphiura Chiajei	..	⅄	⅄	..	..
» filiformis	..	..	..	9/10	..
Ophiopholis aculeata	..	+	..	..	..
Gammaridæ	..	..	..	1/30	1/1
Mysis sp.	..	..	..	1/30	..
Crangon sp.	..	..	..	1/30	..

The sign + = few.
— ⅄ = many.

Drepanopsetta platessoides.

32 investigations, comprising in all at least
122 spec., length 3,5—32 cm, depth 14—51 m.

5030 gr. Fish.

No. of specimens.	Not weighed:																			Weighed: 62.	
	?	?	?	6.	4.	10.	2.	2.	2.	2.	1.	1.	2.	9.	6.	2.	1.	1.	5.	1.	
Abra alba	...	..	..	..	..	..	..	..	..	..	..	..	1/3	..	..	..	..	..	..	...	
» nitida	...	..	..	1/8	4/5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	...	
Leda pernula	...	..	..	..	..	..	..	..	..	..	..	..	2/3	..	..	..	..	..	..	...	
» sp.	...	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	...	
Polychæta	...	..	..	1/8	1/5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	...	
Nemertini	...	..	..	..	..	..	1/4	..	..	..	..	..	..	..	..	..	..	..	..	...	
Amphiura sp.	...	..	..	..	..	1/10	..	..	..	..	..	..	..	..	..	..	..	..	..	...	25,00
Ophioglypha albida	⅄	..	..	..	..	1/10	..	..	..	1/2	1/2	1/1	..	1/1	1/2	..	..	1/1	1/1	...	98,50
» robusta	...	..	..	..	..	..	..	1/1	..	..	..	..	..	..	..	..	..	..	..	...	18,00
» affinis	...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	...	7,50
» sp.	...	..	⅄	1/2	..	..	..	..	1/1	..	..	..	..	..	..	1/1	..	..	..	...	1,87
Gammaridæ	...	..	..	1/4	..	..	..	..	..	..	..	..	..	..	..	..	1/1	..	..	...	1,00
Moera Loveni	...	..	..	..	..	1/10	..	..	..	..	..	..	..	..	..	..	..	..	..	...	
Haploops tubicola	...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	...	2,63
Mysis mixta	...	..	..	..	.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	...	18,00
» sp.	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	...	1,00
Crangon Allmani	...	..	..	..	..	1/5	..	..	..	..	..	..	..	..	1/2	..	..	..	..	...	5,00
» sp.	+	⅄	..	..	..	..	..	..	..	1/2	..	..	..	..	..	..	..	..	..	1/1	13,00
Actinozoa	...	..	..	..	..	1/2	..	..	..	..	..	..	..	..	..	..	..	..	..	...	
Pleuronectes limanda	...	..	..	..	..	..	3/4	..	..	..	..	..	..	..	..	..	..	..	..	...	
Lumpenus lampetriformis	...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	...	+
Gobius sp.	...	..	..	..	..	..	..	..	..	..	1/2	..	..	..	..	..	..	..	..	...	

Total stomach content gr.	191,50
Proportion of rough weight of stomach content to weight of body	(1/26)

The sign + = few.
» ⅄ = many.

150,87

40,63

feed first and foremost on bivalves *(Solen, Mactra, Tellina fabula* etc.), then echinoderms, and only to a slight degree on Crustacea. [1])

The long rough dab *(Drepanopsetta platessoides)* has been investigated from the Kattegat, Samsø Belt, Great Belt and Little Belt; from the results, it would seem to feed on echinoderms and Crustacea, contenting itself, however, at times with bivalves *(Abra alba, A. nitida, Leda),* Polychæta and fish (dab, *Gobius*). In the Belts, its chief food is beyond question the ophiuroid *Ophioglypha albida;* in the Kattegat also the *Amphiura* species. The crustaceans are mostly *Crangon,* especially *C. Allmani,* and *Gammaridæ.*

Rhombus maximus. 12 investigations, comprising in all ca. 11 spec., length 16—37 cm, depth 4—27 m.			2975 gr. Fish.		**Rhombus lævis.** 10 investigations, comprising in all ca. 13 spec., length 7—44 cm, depth 0,5—16 m.				4525 gr. Fish.	
No. of specimens.	Not weighed: ?	Not weighed: 1.	Weighed: 9.		Not weighed: ?	Not weighed: 1.	Not weighed: 1.	Not weighed: 2.	Weighed: 8.	
Crangon vulgaris	....	....	6,00	6,00	..	..	..	1/1	5,00	5,00
» sp.	....	....			..	1/1	..	..		
Gadus merlangus	....	....	10,00		..	..	..	..		
Pleuronectes limanda	....	....	37,00		..	..	..	..	10,00	
Ammodytes sp.	1/1	....			..	..	..	..		
Clupea harengus	....	....	20,00	102,00	⅄	..	..	..	10,00	
Lumpenus lampetriformis	....	1/1			..	..	..	..		25,00
Gobius minutus	....	....	22,00		..	..	..	..		
» sp.	....	....			+	..	1/1	..		
Remains of fish	....	....	13,00		..	..	..	..	5,00	
Total stomach content gr.			108,0		.....				30,0	
Proportion of rough weight of stomach content to weight of body			(1/28)		.....				(1/151)	

The sign + = few.
» ⅄ = many.

The turbot *(Rhombus maximus)* feeds almost exclusively on fish, devouring dabs, whiting, herring, sand eels *(Ammodytes) Lumpenus* and *Gobius.* Only in the Baltic has a turbot once been found with remains of *Crangon vulgaris;* the remaining investigations are all from the Kattegat, the Great Belt, the Limfjord and the western Baltic. In the North Sea also, the turbot is, according to Todd (l. c.) exclusively a fish-eater.

The Brill *(Rhombus lævis)* eats both fish and Crustacea. The investigations

[1]) I have since examined 109 haddock from the North Sea (54 miles SW by W of Thyborøn, 50 m depth); they weighed 66 kilos and contained 2 kilos of food, 9/10 of which was made up of *Amphiura filiformis*; 1/20 of *Paguridæ* and other crustaceans, the remainder various Polychæta and small bivalves; i. e. a result entirely different from Todd's.

which were made in the Kattegat, Samsø Belt and the Limfjord, show that it here devours dabs, herring and gobies, besides *Crangon vulgaris*. In the North Sea also this fish, according to Todd, (l. c.) feeds on both fish and Crustacea.

The spur dogfish *(Acanthias vulgaris)* doubtless feeds chiefly on fish and Crustacea in our waters. The investigations, from the Kattegat, Samsø Belt and

Acanthias vulgaris.

18 investigations, comprising in all ca. 225 spec., length 51—93 cm, depth 14—ca. 50 m. — 38800 gr. Fish.

No. of specimens.	Not weighed:														Weighed: 23.
	51.	42.	?	?	?	?	?	9.	3.	82.	1.	1.	7.	1.	
Nereis sp.	..	..	..	..	..	..	..	..	..	..	..	..	1/20	..	
Carcinus mænas	..	..	+	..	⅄	..	..	..	1/5	..	..	..	..	..	
Crangon vulgaris	..	..	..	..	..	..	..	..	..	..	..	..	..	1/1	
Actinozoa	..	..	..	..	..	..	..	..	..	3/4	..	..	..	..	55,00
Ctenophora	⅄	+	..	..	..	..	⅄	1/2	1/5	..	..	1/1	..	..	
Gadus callarias	+	..	⅄	..	..	..	..	..	..	..	..	..	..	..	
» merlangus	+	+	..	..	..	..	..	..	..	..	..	..	..	..	
Pleuronectes limanda	..	+	+	..	..	..	..	..	..	..	..	..	9/20	..	
Zoarces viviparus	+	..	..	..	..	..	..	..	..	..	..	..	..	..	
Clupea harengus	..	..	..	..	..	⅄	..	1/2	..	..	1/1	..	1/2	..	495,00
Remains of fish	..	..	..	⅄	..	+	..	+	3/5	1/4	..	..	..	..	

Total stomach content gr ... 550,0

Proportion of rough weight of stomach content to weight of body ... (1/71)

The sign + = few.
» ⅄ = many.

Great Belt, have shown that it devours cod, whiting, dab, herring, sand eels, and we have at the Biological Station the head of a large eel, found in the stomach of one of these fish. Of crustaceans, it eats crabs, *Crangon vulgaris*, and others. In the Great Belt, we have in addition found a number of sea-anemones *(Actinozoa)* in the stomach, and in the Bay of Aarhus a few *Nereis sp.* In the North Sea, *Acanthias* devours, according to Todd (l. c.) a not inconsiderable quantity of *Gephyrea (Echiurus)*. It is remarkable to note that these fish also, in our waters, like *Cyclopterus lumpus*, frequently fill their stomach with *Ctenophora;* these can, however, from the slight amount of dry matter they contain, hardly be of any value as nourishment.

The rays and skates *(Raja radiata, R. batis, R. clavata)* feed likewise mainly on fish and Crustacea. The species here most common, *R. radiata*, lives in the Kattegat largely on *Paguridæ*, which are found in large numbers (without the borrowed shell) in their stomachs. Of fish, it will eat dabs, herring, Gobius, sticklebacks and others, and finally, consumes also a quantity of Polychæta, e. g. *Nephthys, Ophelia* and *Ammotrypane*. The investigations noted in the lists are from the Kattegat, Great Belt and Samsø Belt. *R. batis* and *R. clavata* are known in our waters only from the Kattegat; the former here eats for instance

	Raja radiata. 17 investigations, comprising in all ca. 50 spec., length 17—47 cm, depth 7—51 m.													8120 gr. Fish.		**Raja batis.** 4 investigations comprising in all 4*) spec., length 52—83 cm, depth 51 m.		4000 gr. Fish.		**Raja clavata.** 2 investigations comprising in all 4 spec.	
No. of specimens.	Not weighed:													Weighed 16.		Not weighed:		Weighed 1.		Not weighed:	
	?	1.	1.	5.	2.	3.	6.	2.	2.	4.	1.	3.	2.			1.	1.			1.	3.
Polychæta	+	..	..	..	1/4	..	..	..	..	..	..	..	..			....	....			ℵ	....
Nephthys sp.	..	..	..	..	..	..	1/2	..	..	..	..	1/3	..	39,30	51,30	....	....			....	....
Ophelia limacina	..	..	..	..	..	..	..	..	..	..	..	..	..			....	....			....	....
Ammotrypane aulogaster	..	..	..	..	..	..	..	..	..	1/2	..	..	..	12,00		....	....			....	....
Gammarider	..	..	..	..	1/2	..	..	1/2	..	..	..	1/3	..	2,00	42,00	....	....			....	1/2
Idothea sp.	..	..	..	..	..	..	..	..	..	..	..	+	..			....	....			....	....
Arcturus sp.	..	..	..	..	..	..	..	..	..	..	..	+	..			....	....			....	....
Mysis mixta	..	..	..	..	..	..	..	..	19/20	..	..	1/3	..			....	....			....	....
Hyas coarctatus	..	..	..	..	..	..	..	..	..	..	..	..	..	11,20		....	....			....	....
» sp.	..	..	1/2	..	..	..	..	..	..	..	..	..	..			....	....			....	....
Eupagurus Bernhardus	..	..	..	..	..	..	1/4	1/2	..	1/2	..	..	..	2,00		....	....			....	....
» sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	1,90		....	....			....	....
Carcinus mænas	..	..	..	..	..	..	..	..	..	..	..	..	..			....	....			+	1/2
Paguridæ	..	..	..	3/4	1/4	1/1	..	..	..	..	..	..	..	23,00		....	....			....	....
Crangon vulgaris	..	.	..	..	..	..	..	..	..	..	..	..	1/2			....	....			....	....
» Allmani	..	..	1/4	..	..	..	..	..	1/20	..	..	..	..	1,90		....	....	40,00	40,00	....	....
» sp.	..	..	..	..	..	..	1/4	..	..	..	1/3	..	..			....	....			....	....
Pandalus sp.	..	..	..	..	..	..	..	..	..	..	..	..	..			....	ℵ			....	....
Cephalopoda (Rossia?)	..	..	1/4	..	..	..	..	..	..	..	..	..	..			....	....			....	....
Drepanopsetta platessoides	..	..	..	..	..	..	..	..	..	..	..	..	..			....	....	80,00	120,00	....	....
Pleuronectes limanda	..	..	..	..	..	..	..	..	..	..	1/3	..	..			....	....			....	....
Scomber scomber	..	..	..	..	..	..	..	..	..	..	..	..	..			1/1	....			....	....
Clupea harengus	..	..	..	1/4	..	..	..	..	..	..	..	..	..			....	....			....	....
Gobius Ruthensparri	..	..	..	..	..	..	..	..	..	..	..	..	..	3,30	6,70	....	....			....	....
» sp.	..	..	..	..	+	..	..	..	..	..	1/3	..	..			....	....			....	....
Gasterosteus aculeatus	..	..	..	..	..	..	..	..	..	..	..	..	1/2	3.40		....	....	40,00		....	....
Remains of fish	ℵ	1/1	..	..	..	..	..	..	..	..	..	..	..			....	....			....	....
Total stomach content gr.														100,0		....	....	160,0		....	....
Proportion of rough weight of stomach content to weight of body														(1/81)		....	....	(1/25)		....	....

The sign + = few.
» ℵ = many.

*) 1 specimen was empty.

mackerel, long rough dab and *Pandalus;* the latter *inter alia* crabs, Gammaridæ and Polychæta. According to Todd, however, it will in the North Sea also feed on fish.

The sharp tailed Lumpenus *(Lumpenus lampetriformis)* has been investigated from the Great Belt, Little Belt and the Baltic. It feeds on bivalves, Poly-

Lumpenus lampetriformis.

10 investigations comprising in all ca. 74 spec., length 17—28 cm, depth 13—35 m.

760,0 gr. Fish.

No. of specimens.	Not weighed: ?	?	?	5.	1.	2.	1.	Weighed: 62.	
Abra alba	....	....	....	⅄	1/2	....	....	0,33	0,33
Macoma baltica	⅄	....	⅄	....	....	9/10	1/1		
Polychæta	+	⅄	....	....	....	....	....		
Polynoida	....	....	....	....	....	....	....	0,66	3,20
Spionidæ	....	....	....	....	....	....	....	1,88	
Artacama proboscidea	....	....	....	....	....	....	....	0,66	
Gammaridæ	....	....	....	....	....	1/20	....		
Diastylis sp.	....	....	....	....	1/2	1/20	....		
Mysis mixta	....	....	....	....	....	....	....	+	
Harpactida	....	....	....	....	....	....	....	2,81	5,62
Ostracoda	....	....	....	....	....	....	....	2,81	
Remains of Zostera	....	....	....	+	....	....	....		
Detritus	....	....	....	+	....	....	....	9,15	9,15

Total stomach content gr.... 18,30

Proportion of rough weight of stomach content to weight of body... (1/42)

The sign + = few.
» ⅄ = many.

chæta and Crustacea, in the Belts it takes *Abra alba;* in the Baltic *Macoma baltica;* also small Polychæta such as *Spionidæ* and *Artacama proboscidea*, and small crustaceans such as *Gammaridæ, Diastylis* and *Mysis mixta;* even copepods and ostracods.

XII. Food of the Pelagic Fish.

The pelagic species of fish — herring, sprat, garfish and mackerel — have not been mentioned in the foregoing, as from their manner of life they cannot be said to belong to any particular community, but roam about from place to place. The few investigations I have made with these fish do not permit of general conclusions as to their food; it is certain, however, that they are in our waters very frequently taken with stomach entirely empty. The herring *(Clupea harengus)* (See List p. 69

Clupea harengus. 24 investigations, comprising in all ca. 107 spec., length 9—33 cm, depth 1—30 m.									3254,5 gr. Fish.		**Clupea sprattus.** 6 investigations, comprising in all 50 spec., length 7-15 cm, depth 1-35 m		515 gr. Fish.
No. of specimens.	Not weighed:								Weighed: 77.		Not weighed:		Weighed: 35.
	?	?	?	3.	20.	?	2.	1.			5.	10.	
Mytilus larvæ	..	..	..	..	..	..	..	..			1/2	....	
Polychæta	..	ℵ	..	..	..	..	..	..			...	....	
Crustacea (Schizopoda)	..	..	..	..	..	..	1/2	..			...	....	
Gammaridæ	..	..	..	1/2	..	..	..	..			...	....	
Idothea sp.	..	..	..	1/2	..	..	..	..			...	....	
Mysidæ	..	..	..	..	..	..	..	..	1,00	1,00	...	....	
Copepoda	ℵ	..	ℵ	..	1/1	1/1	1/2	+	11,90	11,90	1/2	1/1	3,6
Cladocera (Bosmina?)	..	..	..	..	..	..	..	1/1			...	....	
Peridinea	..	..	+	..	..	..	..	..			...	....	
Fish eggs	..	..	..	..	..	..	..	..	0,15	0,35	...	....	
Gobius Ruthensparri	..	..	..	..	..	..	..	..	0,20		...	....	
Detritus	..	..	..	..	..	..	..	..	0,15	0,15	...	....	
Total stomach content gr.									13,4		...	....	3,6
Proportion of rough weight of stomach content to weight of body									(1/241)		...	....	(1/143)

The sign + = few.
» ℵ = many.

Scomber scomber. 7 investigations, comprising in all 24 spec., length 25—39 cm.						3900 gr. Fish.	
No. of specimens.	Not weighed:					Weighed: 17.	
	?	?	?	1.	3.		
Lamellibranch larvæ	...	..	..	..	...	0,5	1,0
Gastropod larvæ	...	..	..	..	...	0,5	
Copepoda	...	ℵ	..	1/1	1/1	138,0	
Thysanopoda	...	+	..	..	...		
Cladocera	...	..	..	..	...	1,0	139,0
Bottom-Diatoms	...	..	..	..	+		
Clupea harengus juv.	ℵ	..	ℵ	..	...	10,0	10,0
Fish eggs	...	+	..	..	...		
Total stomach content gr.						150,0	
Proportion of rough weight of stomach content to weight of body						(1/26)	

The sign + = few.
» ℵ = many.

including investigations from the Kattegat, Samsø Belt, Frederikssund, several parts of the Great Belt and the Limfjord) I have occasionally found to contain fish eggs, *Gobius Ruthensparri, Polychæta, Idothea* and *Gammaridæ;* Otherwise its chief food consists of copepods and other small Crustacea, for instance *Mysidæ.* In the sprat *(Clupea sprattus)* (See List p. 69 including investigations from several parts of the Great Belt, W of Skjoldnæs and the Isefjord) and the Garfish *(Belone vulgaris)* for which I can only record a single investigation with positive result — some young specimens from the harbour of Snekkersten — I have only found to contain copepods and gastropod-and lamellibranch larvæ; in the mackerel *(Scomber scomber)* (See List p. 69 including investigations from various parts of the Kattegat and Great Belt) the same, together with herring, whence it will be seen that these fish only to a very slight degree interfere with the relations of the bottom fish with the lower animals. They do not even appear to any essential degree as competitors in the pursuit of food to the small fish feeding on copepods, most of these latter being procured by the pelagic fish out in the open sea, where the small fish are never found.

XIII. Literature.

With regard to other works on the subject of fish food, I know of no previous attemt at making a thorough quantitative investigation of the stomach contents, at any rate, from the Danish waters. Earlier investigators have as a rule furnished long lists of the forms found in the stomach, with never more than a note such as »numerous« or »few« or possibly the number of specimens found, all of which naturally gives no idea as to what animals constitute the chief food of the fish in question. R. A. Todd (Mar. Biol. of the United Kingdom. International Fishery Investigations. First Report on Fishery and Hydrographical Investigations in the North Sea and adjacent Waters (Southern Area) London 1902—03. Second report etc. London 1904—05) has, it is true, endeavoured to give a measure of the frequency with which the different food forms occur in the stomach contents examined, by noting in how many of all the stomachs examined the species concerned was fouud. This method, however, involves the disadvantage that the estimate may often give erroneous results, since a species found in nearly all the stomachs, but with only a slight amount in each, will figure in the lists as of equal importance for the species of fish in question with another which happened to occur in the same number of stomachs, but in far greater total quantity than the former. Todd's paper shows, by the way, that the plaice in the North Sea subsist apparently to no inconsiderable degree upon echinoderms, which, as we have seen in the foregoing, they hardly ever do in the waters within in Skaw. The same writer maintains, in a more recent work (Fishery Investigations, Series II, vol. II, No. 3, 1914) on the food of the plaice in the North Sea, that plaice fast during winter, in which season they live more on Polychæta than on molluscs. That the first applies also to our home waters has already been noted in the foregoing; with regard to the latter point, however, I have not been able to ascertain whether this can be said to be true of our waters.

XIV. Conclusion. Quantitative Consumption of Bottom Fauna by the Fish.

With regard to the question as to which fish contain the greatest amount of food in proportion to their own weight, a comparison of the figures noted at the bottom of the lists for stomach contents, indicating the ratio between stomach contents and weight of body, will show that the flounder is the species with comparatively fullest stomach. Flatfish are on the whole frequently found to have a considerable stomach content as compared with their own weight, and the same applies to the small fish and the sea scorpions. Then come the cod, and last of all the eels and Zoarces; we may here disregard the pelagic fish, of which we have not sufficient investigations to judge. Altogether, the stomach content seems, as is only reasonable, to be greatest among fish feeding on shell-bearing molluscs, lowest in those subsisting on fish and crustaceans, such as cod, eel and Zoarces. It will further be seen from the lists, that in the poor *Tellina tenuis (d. ten.)* communities the fish have a comparatively small stomach content, whereas the *Venus* communities with their masses of small *Mactra subtruncata* and the Limfjord with its quantities of small bivalves, give, on the whole, extremely high figures for the proportion between stomach contents and weight of body. This proportion may vary between $^1/_{24}$ and $^1/_{46}$, giving a mean value of abt. $^1/_{30}$. Supposing the fish to demand, on the average, a daily ration equal to $^1/_{30}$ th of their own weight for 300 days of the year, it follows that they will annually devour ten times their own weight, a figure which has by other means been arrived at by Dr. Petersen, and is quoted by him in his paper on the annual consumption by fish of bottom fauna in the Kattegat (A Preliminary Result of the Investigations on the Valuation of the Sea; Biol. St. Report XXIII, 1915).

It would be interesting if we could have calculated how many Crustacea, Polychæta, molluscs, etc. are annually consumed by each species of fish in a water such as for instance Nyborg Fjord, taking values in the lists here given as a basis; as it is, however, the lack of accurate fishery statistics over an area such as that mentioned renders it impossible to attain even approximate accuracy in such a calculation. Nevertheless, it will easily be understood, that the quantity of lower forms consumed by the fish for food must be very considerable in proportion to the amount of edible bottom fauna generally, when we remember that the ordinary fishery statistics give the annual amount of bottom fish taken per sq. metre surface as 1 gr. (rough weight). From what we have noted above, these fish would require ten times that amount, or roughly 10 gr. of meat per sq. metre surface per annum, a figure which, in proportion to the available quantity of fish food per sq. metre surface (See valuation lists in Appendix to Biol. St. Report XXI 1913) is by no means inconsiderable.

Explanation of the Lists of stomach and Intestine contents.

A reproduction in extenso of the original lists for the separate investigations as to contents of stomach and intestine in the fish examined would take up a disproportionate amount of space, and yet not furnish any clear view of the results; I have therefore, after careful perusal and arrangement of the lists in question, determined to omit various details as to locality, depth, time, age, size, etc., in the case of the species most frequently investigated, publishing only the figures obtained from weighings of the stomach contents (See Lists 1—6 at end of book). In the case of certain species, on the other hand, where weighings of the stomach contents were few or none, I have been obliged to include the investigations where stomach contents were not weighed, and have here noted each investigation separately, the fractions in each of the perpendicular columns to be here taken together; each denotes the proportion represented by the species opposite which it stands in comparison with the total content. In the remaining lists, where the weighings afford a sufficiently good idea as to the composition of the stomach contents, the investigations where weighing was not carried out are omitted, only these where both fish and stomach contents were weighed being here included; the fractions appearing in the original lists for each separate constituent of the total contents are here reckoned out in grammes and added together for each constituent. This lengthy work has been carried out with the greatest care by the Mate of the Station, L. P. Larsen. In cases where one species of fish is found in several different communities, its food in these is treated separately, unless it happens to be the same in all communities. The total number of investigations made, and the number of specimens comprised, will be found noted at the top of the lists. As a matter of fact, the numbers actually examined were far in excess of these figures, as all investigations prior to 1911 have been omitted, owing to the fact that the number of specimens was then not always noted. Naturally, however, these earlier lists have furnished a good deal of information, which has been utilised here and there in the text. As already mentioned, the investigations were made with fresh material, for the most part procured from the $^{s}/_{s}$ »Sallingsund« belonging to the Station. Immediately after capture, the fish were killed and sorted according to species, sometimes also according to size, and the stomachs slit up. After removal of the stomach content, this and the fish itself were separately weighed. The various species of animals found in the stomach were then noted, as also the proportional quantity contributed by each to the total content. The weights now given in the lists are obtained by addition of the figures thus noted for each species.

Gadus callarias.

131 investigations, comprising in all 912 spec., length 2,5—92 cm, depth 1—56 m.

Water	Belts, Baltic.	Kattegat, Belts.	Belts.	Sound, Belts.	Kattegat.	Kattegat, Sound.	Belts, Sound,	Kattegat.	Lim-fjord.	Total	
Community	*d.*	*d. ten.*	*db.*	*bc. Ebca.*	*dv. v. Ev.*	*E. Fil. B. Ch.*	*R. M.*	*Ha.*			
No. of spec.	435	25	38	29	29	52	272	15	17	912	
Weight of Fish in gr.	85160	3090	7060	24820	31700	41235	223860	2320	9350	428595	
Drepanopsetta platessoides					125,0					125,0	
Pleuronectes limanda	78,0			112,3	405,0		1030,0			1625,3	
» sp.						37,4				37,5	
Gadus callarias	100,0									100,0	
» merlangus						80,0	36,0			116,0	
Zoarces viviparus	247,0		69,0	65,0			14,5		41,7	437,2	
Centronotus gunellus							69,5			69,5	
Callionymus maculatus						37,5	49,0			86,5	
Clupea harengus & sprattus	106,7			25,0	66,0					197,7	
Belone vulgaris					2,5					2,5	
Anguilla vulgaris	66,7									66,7	
Gobius niger	262,2		138,0							400,2	
» Ruthensparri	67,9									67,9	
» minutus				10,0	10,0					20,0	
» sp.				10,0					41,7	51,7	
Spinachia vulgaris	37,3		23,0							60,3	
Syngnathus typhle	37,4	14,0								51,4	
Gasterosteus sp.	71,5		23,0							94,5	
Cyclopterus lumpus									3,3	3,3	
Amphioxus lanceolatus					2,5	1,0				3,5	
Fish remains	10,0						165,4		41,6	217,0	
» roe		4,7			250,0		151,0			405,7	4239,4
Neptunea antiqua					28,0		84,3			112,3	
Buccinum undatum				5,0		13,0	44,8			62,8	
Littorina littorea	2,0									2,0	177,1
Aphrodite aculeata		5,0				13,0	52,7		83,3	154,0	
Phyllodoce maculata	3,0				2,5	13,0	46,0			64,5	
Chætopterus sp.							18,7			18,7	
Nereis sp.	6,0		1,5							7,5	
Lepidonotus squamatus							10,0			10,0	
Nephthys sp.	4,0			41,8		340,0	27,2			413,0	
Trophonia plumosa							97,5			97,5	
Arenicola marina		5,0					9,2			14,2	
Terebellidæ						50,0				50,0	
Amphitrite sp.?							18,0			18,0	
Priapulus caudatus				20,8						20,8	
Echiurus sp.					28,0	26,0				54,0	
Nemertini				41,5	28,0		9,1			78,6	1000,8
Ophiopholis aculeata						13,0	2785,3			2798,3	
Ophioglypha sp.			6,0				144,0			150,0	
Strongyloc. drøbakiensis							72,0			72,0	
Phyllophorus pellucidus							37,5			37,5	
Psolus phantapus						13,0	71,7			84,7	3142,5
Crustacéa							68,0			68,0	
Gammaridæ	101,5	5,0	0,9		30,5	13,0	36,0			186,9	
Idothea sp.	114,1				4,5					118,6	
Mysidæ	17,6									17,6	
Diastylis sp.						50,0				50,0	
Caprella			0,6							0,6	
Haploops tubicola								4,0		4,0	
Carcinus mænas	366,8	14,0		129,0	82,0		252,6			844,4	
Portunus sp.						37,5	16,7			54,2	
Hyas sp.				41,8				60,0		101,8	
Inachus dorsettensis						4,0				4,0	
Eupagurus Bernhardus		5,0			160,0	97,5	134,0			396,5	
Paguridæ				31,0	15,0	15,0	15,8			76,8	
Crangon sp.	178,1	28,3	23,0	32,8	10,5		49,0	18,0	27,4	367,1	
Palæmon sp.	103,0									103,0	
Decapoda							27,5		9,3	36,8	2430,3
Cerianthus sp.							36,0			36,0	
Actinozoa						26,0	36,0			62,0	98,0
Lumps of clay									41,7	41,7	
Detritus						100,0				100,0	
Zostera and Algæ	91,7	14,0								105,7	247,4
Stomach content in gr.	2072,5	95,0	285,0	566,0	1250,0	980,0	5715,0	82,0	290,0	11335,5	11335,5
Proportion of rough weight of stomach content to weight of body	($^1/_{41}$)	($^1/_{31}$)	($^1/_{25}$)	($^1/_{44}$)	($^1/_{25}$)	($^1/_{42}$)	($^1/_{39}$)	($^1/_{28}$)	($^1/_{32}$)	($^1/_{38}$)	

Zoarces viviparus. List 2.

74 investigations comprising in all 674 spec., length 6—36 cm, depth 0,5—17 m.

Water	Kattegat, Sound, Belts, Baltic.	Belts.	Limfjord.	Total.	
Community	*d.*	*db.*			
No. of spec.	577	32	65	674	
Weight of Fish in gr.	39105	1170	2930	43205	
Abra alba	. . . . .	27,8	50,0	77,8	
Macoma baltica	52,0	3,6	. . . . .	55,6	
Mya sp.	11,0	. . . . .	. . . . .	11,0	
Solen pellucidus	1,5	. . . . .	. . . . .	1,5	
Cardium sp.	15,0	. . . . .	. . . . .	15,0	
Corbula gibba	0,5	. . . . .	. . . . .	0,5	
Cyprina islandica	0,5	. . . . .	. . . . .	0,5	
Montacuta sp.	. . . . .	2,5	. . . . .	2,5	
Modiolaria discors	10,0	. . . . .	. . . . .	10,0	
Mytilus edulis	4,0	. . . . .	. . . . .	4,0	178,4
Buccinum undatum	16,0	. . . . .	. . . . .	16,0	
Rissoa sp.	47,3	. . . . .	. . . . .	47,3	
Hydrobia sp.	24,0	. . . . .	. . . . .	24,0	
Acera bullata	0,5	2,5	2,0	5,0	92,3
Polychæta	0,8	0,6	. . . . .	1,4	
Lepidonotus squamatus	1,0	. . . . .	. . . . .	1,0	
Harmothoë sp.	1,0	. . . . .	. . . . .	1,0	
Spionidæ	0,5	. . . . .	. . . . .	0,5	
Polynoidæ	5,5	. . . . .	. . . . .	5,5	
Pectinaria Koreni	2,8	6,0	2,0	10,8	
Priapulus caudatus	1,0	. . . . .	. . . . .	1,0	21,2
Flies.	0,5	. . . . .	. . . . .	0,5	
Insect larvæ	70,6	. . . . .	. . . . .	70,6	71,1
Gammaridæ	148,3	. . . . .	0,7	149,0	
Idothea sp.	246,7	. . . . .	0,5	247,2	
Diastylis sp.	. . . . .	6,0	. . . . .	6,0	
Gastrosaccus spinifer	2,0	. . . . .	. . . . .	2,0	
Crangon vulgaris	10,0	. . . . .	. . . . .	10,0	
Palæmon Fabricii	2,5	. . . . .	. . . . .	2,5	416,7
Ascidiæ	10,0	. . . . .	. . . . .	10,0	
Actinozoa	. . . . .	. . . . .	1,0	1,0	11,0
Gobius Ruthensparri	19,4	. . . . .	. . . . .	19,4	
Clupea harengus (remains)	5,0	. . . . .	. . . . .	5,0	
Fish eggs	0,5	. . . . .	. . . . .	0,5	24,9
Algæ	54,5	. . . . .	. . . . .	54,5	
Zostera fragments.	32,9	. . . . .	. . . . .	32,9	
Plant detritus	18,7	. . . . .	. . . . .	18,7	
Detritus	26,5	. . . . .	. . . . .	26,5	
Sand	6,0	. . . . .	. . . . .	6,0	138,6
Total stomach content gr.	849,0	49,0	56,2	954,2	954,2
Proportion of rough weight of stomach content to weight of body	($^1/_{46}$)	($^1/_{24}$)	($^1/_{52}$)	($^1/_{45}$)	

Anguilla vulgaris. List 3.

88 investigations comprising in all 641 spec., length 7—93 cm, depht 0,5—12 m.

Community	d.	Limfjord.	Total.	
No. of spec.	457	184	641	
Weight of Fish in gr.	63200	24480	87680	
Abra alba	.....	48,0	48,0	
Macoma baltica	4,8	.....	4,8	
Mya truncata (Siphon)	9,4	1,5	10,9	
» arenaria juv. (and Siphon)	5,0	.....	5,0	
Scrubicularia plana	9,0	.....	9,0	
Solen pellucidus	.....	267,0	267,0	
Cardium exiguum	12,0	.....	12,0	
Nucula nitida	.....	5,0	5,0	
Modiolaria discors	12,0	.....	12,0	
Mytilus edulis	47,4	.....	47,4	421,1
Buccinum undatum	.....	13,0	13,0	
Littorina littorea	17,5	.....	17,5	
» obtusata	2,0	.....	2,0	
Rissoa sp.	8,0	.....	8,0	
Cerithium reticulatum	1,0	.....	1,0	
Lacuna pallidula	6,0	.....	6,0	
Philine aperta	.....	95,0	95,0	
Acera bullata	.....	60,4	60,4	202,9
Polychæta	.....	5,0	5,0	
Lepidonotus squamatus	1,0	.....	1,0	
Nereis sp.	35,0	9,0	44,0	
Arenicola marina	86,4	.....	86,4	
Pectinaria Koreni	1,0	227,5	228,5	
Terebellidæ	.....	38,0	38,0	
Amphitrite sp. (?)	38,9	20,0	58,9	
Chætopoda	2,0	.....	2,0	
Echiurus sp.	.....	10,0	10,0	473,8
Insect larvæ	3,0	0,6	3,6	3,6
Gammaridæ	69,0	1,5	70,5	
Idothea sp.	266,7	1,5	268,2	
Mysidæ	0,5	.....	0,5	
Carcinus mænas	174,3	12,0	186,3	
Crangon vulgaris	8,9	.....	8,9	
Palæmon sp.	4,2	.....	4,2	538,6
Actinia viduata	.....	1,5	1,5	1,5
Zoarces viviparus	162,8	.....	162,8	
Gobius niger	40,0	.....	40,0	
» minutus	.....	20,5	20,5	
» sp.	12,0	.....	12,0	
Spinachia vulgaris	6,6	.....	6,6	
Gasterosteus aculeatus	84,4	.....	84,4	
» pungitius	4,0	.....	4,0	
Fish remains	5,1	.....	5,1	
» roe	5,0	.....	5,0	340,4
Zostera remains	2,2	.....	2,2	
Detritus	3,2	6,0	9,2	11,4
Total stomach content in gr.	1150,3	843,0	1993,3	1993,3
Proportion of rough weight of stomach content to weight of body	(1/55)	(1/29)	(1/44)	

Pleuronectes platessa.

List 4.

159 investigations, comprising in all 2515 spec., length 1,8—48 cm, depth 0,5—35 m.

Water	Belts, Baltic.	Kattegat, Belts.	Belts.	Baltic.	Belts.	Belts.		Kattegat.	Kattegat, Sound.	Lim-fjord.	Total.	
Community	*d.*	*d. ten.*	*db.*	*da.*	*b, bc.*	*ac. (b).*	*Ebc.*	*dv., v., Ev.*	*E. Fil. Ch ± R. M.*			
No. of spec.	164	126	133	31	98	199	377	264	30	1093	2515	
Weight of Fish in gr.	16140	22400	16820	2200	16150	34915	63870	44955	9475	138360	365285	
Abra alba	0,5	.....	52,2	.....	295,0	31,5	1015,0	.....	.....	814,3	2238,5	
» nitida	.....	.....	.....	.....	.....	.....	.....	.....	.....	423,7	423,7	
Macoma calcarea	.....	.....	.....	.....	28,0	290,0	20,0	4,0	84,5	.....	426,5	
» baltica	62,5	.....	61,0	5,0	.....	.....	.....	.....	.....	270,0	398,5	
Tellina fabula	.....	.....	.....	.....	.....	.....	.....	9,0	.....	.....	9,0	
» tenuis	.....	36,0	.....	.....	.....	.....	.....	.....	.....	.....	36,0	
Mya truncata	.....	5,0	.....	.....	.....	.....	.....	.....	.....	59,9	64,9	
» arenaria	27,6	.....	.....	.....	.....	.....	.....	.....	.....	.....	27,6	
Solen pellucidus	.....	.....	.....	.....	.....	.....	.....	.....	.....	1423,5	1428,5	
Corbula gibba	2,0	.....	.....	.....	.....	.....	.....	5,0	.....	243,1	245,1	
Mactra subtruncata	.....	.....	.....	.....	.....	.....	.....	.....	.....	13,0	862,5	
» solida, elliptica & sp.	.....	.....	.....	.....	.....	.....	.....	849,5	.....	.....	18,0	
Thracia sp.	.....	12,5	.....	.....	.....	.....	.....	.....	18,0	.....	12,5	
Cyprina islandica juv.	.....	.....	.....	.....	6,7	5,0	339,0	.....	.....	.....	350,7	
Leda pernula	.....	.....	.....	.....	.....	.....	3,5	.....	.....	.....	3,5	
» minuta	.....	.....	.....	.....	.....	.....	3,5	.....	.....	.....	3,5	
Cardium edule	21,3	7,5	.....	.....	.....	.....	.....	.....	.....	0,4	29,2	
» fasciatum	0,8	7,5	8,0	.....	.....	.....	.....	.....	.....	40,0	56,3	
» sp.	4,6	.....	3,8	.....	.....	.....	.....	.....	.....	.....	8,4	
Nucula nitida	.....	.....	.....	.....	.....	.....	.....	.....	.....	74,0	74,0	
» tenuis	.....	.....	.....	.....	.....	31,5	1281,0	.....	8,0	.....	1320,5	
Modiolaria nigra	.....	.....	.....	.....	.....	13,0	.....	.....	.....	.....	13,0	
Mytilus edulis	111,8	.....	2,2	3,0	.....	.....	.....	.....	.....	.....	117,0	8167,4
Lacuna divaricata	.....	15,8	.....	.....	.....	.....	.....	2,3	.....	.....	18,1	
Cerithium sp.	.....	.....	.....	2,0	.....	.....	.....	.....	.....	.....	2,0	
Hydrobia sp.	205,4	.....	87,5	20,0	.....	.....	.....	.....	.....	.....	312,9	
Rissoa sp.	28,5	.....	.....	.....	.....	.....	.....	8,6	.....	.....	37,1	
Philine aperta & sp.	.....	.....	.....	.....	.....	.....	.....	27,0	.....	33,0	60,0	
Acera bullata	.....	.....	.....	.....	.....	.....	.....	.....	.....	544,0	544,0	974,1

Goniada maculata	.....	.....	.....	.....	.....	15,0	.....	8,0	.....	.....	23,0	
Aricia armiger	.....	6,0	.....	2,5	.....	.....	.....	.....	.....	0,2	8,7	
Nephthys sp.	.....	51,7	45,6	.....	153,3	205,6	148,0	232,1	87,0	203,6	1126,9	
Ophelia limacina	.....	44,7	.....	.....	.....	30,0	.....	5,0	.....	.....	79,7	
Trophonia plumosa	.....	.....	.....	.....	.....	15,0	.....	.....	.....	.....	15,0	
Ammotrypane aulogaster	.....	.....	.....	.....	.....	.....	.....	12,5	68,0	... ...	80,5	
Travisia Forbesi	2,5	.....	.....	2,5	.....	.....	.....	29,0	13,0	.....	47,0	
Arenicola marina	43,0	58,5	64,6	2,0	85,0	72,0	25,0	476,7	.....	.....	826,8	
Pectinaria Koreni	12,0	35,8	68,0	.....	8,0	.....	21,0	32,0	.....	327,8	504,6	
» belgica & sp.	.....	30,0	.....	.....	.....	.....	.....	8,0	6,3	.....	44,3	
Terebellidæ	.....	.....	.....	.....	46,0	33,9	34,0	.....	19,2	.....	133,1	
Polychæta in tubes	.....	.....	.....	.....	.....	10,0	.....	.....	.....	.....	10,0	
Lanice conchylega	.....	.....	.....	.....	.....	.....	.....	10,0	.....	.....	10,0	
Priapulus caudatus	.....	.....	9,0	.....	10,0	10,0	.....	.....	.....	.....	29,0	
Halicryptus spinulosus	6,3	.....	.....	.....	.....	.....	.....	.....	.....	.....	6,3	
Nemertini	.....	.....	8,0	.....	.....	.....	.....	2,0	.....	44,3	54,3	
Planaria	.....	.....	.....	.....	.....	1,5	.....	.....	.....	.....	1,5	3322,9
Gammaridæ	.....	6,0	84,3	.....	18,0	4,0	7,0	69,5	.....	1,0	189,8	
Crangon sp.	.....	.....	.....	.....	.....	.....	.....	2,3	.....	.....	2,3	
Idothea sp.	.....	.....	0,4	.....	.....	2,0	.....	.....	.....	.....	2,4	
Diastylis sp.	.....	.....	.....	.....	.....	.....	7,0	.....	.....	.....	7,0	
Carcinus mænas	.....	.....	0,4	.....	.....	.....	.....	.....	.....	.....	0,4	201,9
Zoarces viviparus	.....	.....	5,0	.....	.....	.....	.....	.....	.....	.....	5,0	5,0
Sand and Gravel	.....	3,0	.....	3,0	.....	.....	.....	.....	.....	.....	6,0	6,0
Total stomach content in gr..	531,3	320,0	500,0	40,0	650,0	835,0	2975,0	1815,0	330,0	4681,0	12677,3	12677,3
Proportion of rough weight of stomach content to weight of body	($^1/_{30}$)	($^1/_{70}$)	($^1/_{34}$)	($^1/_{55}$)	($^1/_{25}$)	($^1/_{42}$)	($^1/_{21}$)	($^1/_{25}$)	($^1/_{29}$)	($^1/_{30}$)	($^1/_{29}$)	

Pleuronectes limanda.

List 5.

118 investigations comprising in all 1482 spec., length 1,9—37 cm, depth 0,5—51 m.

Water	Belts, Sound, Baltic.	Kattegat, Belts.	Belts, Sound, Isefjord.	Baltic.	Belts.	Kattegat.	Kattegat.	Kattegat, Samsø Belt.	Kattegat.	Lim-fjord.	Total.	
Community	*d.*	*d. ten.*	*db.*	*da.*	*bca., Ebca.*	*dv., v., Ev.*	*E. Fil. B. Ch.*	*R. M.*	*Ha.*			
No. of spec.	260	49	122	27	565	178	51	78	7	145	1482	
Weight of Fish in gr.	16380	5120	8775	850	41725	14950	4230	4555	240	11675	108500	
Abra alba	60,0	.....	67,8	.....	328,0	.....	.....	.....	.....	72,7	528,5	
» nitida	.....	.....	.....	.....	.....	.....	.....	.....	.....	55,0	55,0	
Macoma calcarea	.....	.....	.....	.....	10,0	.....	.....	.....	.....	.....	10,0	
» baltica	14,8	.....	18,8	4,3	6,2	.....	.....	.....	.....	.....	44,1	
Mya arenaria	55,7	.....	.....	2,0	.....	.....	.....	.....	.....	.....	57,7	
Corbula gibba	7,0	.....	.....	.....	5,0	.....	.....	.....	.....	.....	12,0	
Mactra subtruncata	.....	12,0	.....	.....	.....	106,3	.....	.....	.....	.....	118,3	
Solen pellucidus	.....	.....	.....	.....	.....	.....	.....	.....	.....	70,8	70,8	
» sp.	.....	.....	.....	.....	.....	6,3	3,8	.....	.....	.....	10,1	
Cyprina islandica	.....	.....	.....	.....	1,7	.....	.....	.....	.....	.....	1,7	
Cardium edule	12,2	.....	.....	.....	.....	.....	.....	.....	.....	.....	12,2	
» fasciatum	24,0	.....	.....	.....	7,7	.....	.....	.....	.....	.....	31,7	
Montacuta ferruginosa	.....	.....	.....	.....	4,2	3,1	.....	.....	.....	.....	7,3	
Mytilus edulis	39,8	.....	.....	9,0	.....	.....	.....	.....	.....	.....	48,8	1008,2
Buccinum undatum	.....	.....	.....	.....	18,3	.....	.....	.....	.....	.....	18,3	
Lacuna divaricata	.....	2,7	.....	.....	2,5	.....	.....	.....	.....	.....	5,2	
Hydrobia sp.	10,5	.....	.....	.....	.....	.....	.....	.....	.....	.....	10,5	
Rissoa sp.	14,6	0,6	.....	.....	.....	.....	.....	.....	.....	.....	15,2	
Philine sp	.....	.....	.....	.....	.....	6,3	3,7	.....	.....	85,0	95,0	
Acera bullata	.....	.....	.....	.....	68,0	.....	.....	.....	.....	155,0	223,0	
Eggs of Gastropods	1,0	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,0	368,2
Polychæta	.....	.....	1,2	.....	.....	.....	.....	.....	.....	2,5	3,7	
Phyllodoce maculata	.....	.....	.....	.....	.....	36,6	.....	.....	.....	.....	36,6	
Nereis sp.	.....	.....	.....	.....	6,0	.....	.....	.....	.....	75,5	81,5	
Aricia armiger	.....	.....	.....	.....	.....	2,1	.....	.....	.....	.....	2,1	
Nephthys sp.	.....	2,0	4,7	.....	52,5	18,0	8,0	.....	.....	1,0	86,2	
Travisia Forbesi	.....	.....	.....	4,0	.....	.....	.....	.....	.....	.....	4,0	
Ammotrypane aulogaster	.....	.....	.....	.....	2,5	.....	.....	2,7	.....	.....	5,2	
Trophonia plumosa	.....	.....	.....	.....	18,0	.....	.....	.....	.....	.....	18,0	
Arenicola marina	56,4	5,2	46,5	.....	12,3	8,2	.....	.....	.....	.....	128,6	
Notomastus latericius	.....	.....	.....	.....	14,0	.....	.....	.....	.....	.....	14,0	
Pectinaria Koreni	24,0	.....	65,3	.....	13,7	7,1	.....	.....	.....	26,0	136,1	
» sp.	.....	.....	.....	.....	.....	.....	2,5	2,7	.....	.....	5,2	
Terebellidæ	30.0	.....	.....	.....	38,3	.....	2,5	24,6	.....	.....	95,4	
Spionidæ	2,3	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,3	
Lanice conchylega	.....	.....	.....	.....	.....	110,2	.....	.....	.....	.....	110,2	
Sabellidæ	.....	.....	.....	.....	.....	.....	2,5	.....	.....	.....	2,5	
Echiurus	.....	.....	.....	.....	8,7	.....	.....	.....	.....	.....	8,7	
Priapulus caudatus	.....	.....	3,0	.....	14,3	.....	.....	.....	.....	.....	17,3	
Nemertini	.....	.....	.....	.....	.....	6,2	.....	.....	.....	10,2	16,4	

Plattaria												
Amphiura filiformis							7,5				7,5	
» sp.							18,0				18,0	
Ophioglypha albida	18,0	7,5	12,0		467,3	97,0		50,7			652,5	
» texturata										14,0	14,0	
» robusta								82,7			82,7	
» affinis								65,6			65,6	
» sp.			5,0					1,5			6,5	
Echinocardium cordatum juv.					17,5	41,0					58,5	
Echinus miliaris					8,8						8,8	
Echinocyamus pucillus					1,5	7,0		4,0			12,5	926,6
Insect larvæ	10,7										10,7	10,7
Gammaridæ	18,8		57,0		6,4	24,7		2,8			109,7	
Haploops tubicola									5,0		5,0	
Idothea sp.	21,0	5,0	2,3		18,8	29,5					76,6	
Mysidæ	14,7		2,3		21,3						38,3	
Diastylis sp.					7,0			0,7			7,7	
Eupagurus sp.						6,2	31,5				37,7	
Gastrosaccus spinifer					2,5						2,5	
Carcinus mænas					12,5					26,7	39,2	
Crangon sp.	23,3		3,0	5,0	35,9					35,6	102,8	
Palæmon sp.						7,0					7,0	426,5
Actinozoa										15,0	15,0	15,0
Hydroidæ		15,0									15,0	15,0
Ulva lactuca	15,0										15,0	
Sand				4,7							4,7	19,7
Zoarces viviparus			35,1		10,0						45,1	
Gasterosteus aculeatus	11,9										11,9	
Clupea sp.					13,4						13,4	
Gobius sp.	2,5	15,0			9,0						26,5	
Fish roe	1,0					4,2					5,2	102,1
Total stomach content in gr.	489,2	65,0	324,0	29,0	1267,8	527,0	80,0	238,0	5,0	645,0	3670,0	3670,0
Proportion of rough weight of stomach content to weight of body	$(^1/_{33})$	$(^1/_{79})$	$(^1/_{27})$	$(^1/_{29})$	$(^1/_{33})$	$(^1/_{28})$	$(^1/_{53})$	$(^1/_{19})$	$(^1/_{48})$	$(^1/_{18})$	$(^1/_{30})$	

Pleuronectes flesus.

List 6.

72 investigations comprising in all 258 spec., length 1,8—44 cm, depth 0,5—30 m.

Water	Belts, Isefjord, Baltic.	Kattegat, Belts.	Kattegat, Belts, Isefjord.	Belts.	Kattegat.	Lim-fjord.	Total.	
Community	*d.*	*d. ten.*	*db.*	*bca., Ebca.*	*dv., v., Ev.*			
No. of spec.	117	18	24	28	27	44	258	
Weight of Fish in gr.	14220	2125	6375	8210	8110	8910	47950	
Abra alba	41,1	. . . . .	150,0	135,5	. . . . .	45,0	371,6	
» nitida	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	25,0	25,0	
Macoma calcarea	. . . . .	. . . . .	. . . . .	10,0	. . . . .	. . . . .	10,0	
» baltica	79,5	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	79,5	
Mya truncata	. . . . .	. . . . .	1,0	. . . . .	. . . . .	2,0	3,0	
» arenaria	55,9	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	55,9	
Corbula gibba	90,0	. . . . .	. . . . .	. . . . .	. . . . .	5,0	95,0	
Solen pellucidus	1,0	. . . . .	8,0	. . . . .	. . . . .	88,0	97,0	
Cardium edule	0,4	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	0,4	
Mactra sp. juv.	. . . . .	. . . . .	. . . . .	. . . . .	230,0	. . . . .	230,0	
Mytilus edulis juv.	111,4	17,5	. . . . .	. . . . .	. . . . .	. . . . .	128,9	1096,3
Rissoa sp.	176,1	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	176,1	
Hydrobia sp.	11,0	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	11,0	
Lacuna divaricata	9,0	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	9,0	
Philine aperta	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	6,2	6,2	
Acera bullata	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	18,8	18,8	221,1
Nereis sp.	1,3	. . . . .	. . . . .	40,0	. . . . .	60,0	101,3	
Aricia armiger	4,5	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	4,5	
Nephthys sp.	. . . . .	. . . . .	. . . . .	15,5	. . . . .	5,0	20,5	
Travisia Forbesi	4,0	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	4,0	
Arenicola marina	24,7	6,7	. . . . .	. . . . .	30,0	. . . . .	61,4	
Pectinaria Koreni	8,9	. . . . .	171,0	. . . . .	40,0	. . . . .	219,9	
Spionidæ	6,8	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	6,8	418,4
Insect larvæ	2,2	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	2,2	2,2
Gammaridæ	15,1	15,4	19,0	. . . . .	175,0	. . . . .	224,5	
Idothea sp.	13,6	15,4	1,0	. . . . .	. . . . .	. . . . .	30,0	
Crangon sp.	3,4	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	3,4	257,9
Gobius Ruthensparri	5,5	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	5,5	
» minutus	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	5,0	5,0	
Gasterosteus aculeatus	15,0	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	15,0	25,5
Algæ	0,7	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	0,7	
Dead Zostera	. . . . .	. . . . .	. . . . .	4,0	. . . . .	. . . . .	4,0	
Sand	5,0	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	5,0	9,7
Total stomach content in gr.	686,1	55,0	350,0	205,0	475,0	260,0	2031,1	2031,1
Proportion of rough weight of stomach content to weight of body	($^1/_{21}$)	($^1/_{39}$)	($^1/_{18}$)	($^1/_{40}$)	($^1/_{17}$)	($^1/_{34}$)	($^1/_{24}$)	

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Independent Publications.

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By *C. G. Joh. Petersen,* excepting:

Report XIII. *A. Otterstrøm.*
— XIV, II. *K. J. Gemzøe.*
— XVI. *C H. Ostenfeld.*
— XX, I. II. *Petersen* og *Boysen Jensen,* and some few smaller papers by other writers